# SCIENTIFIC AMERICAN

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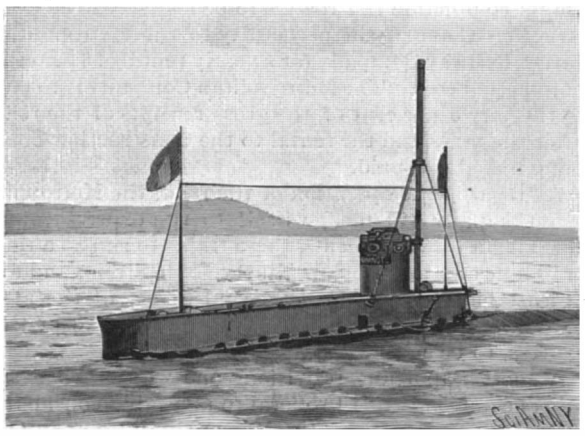
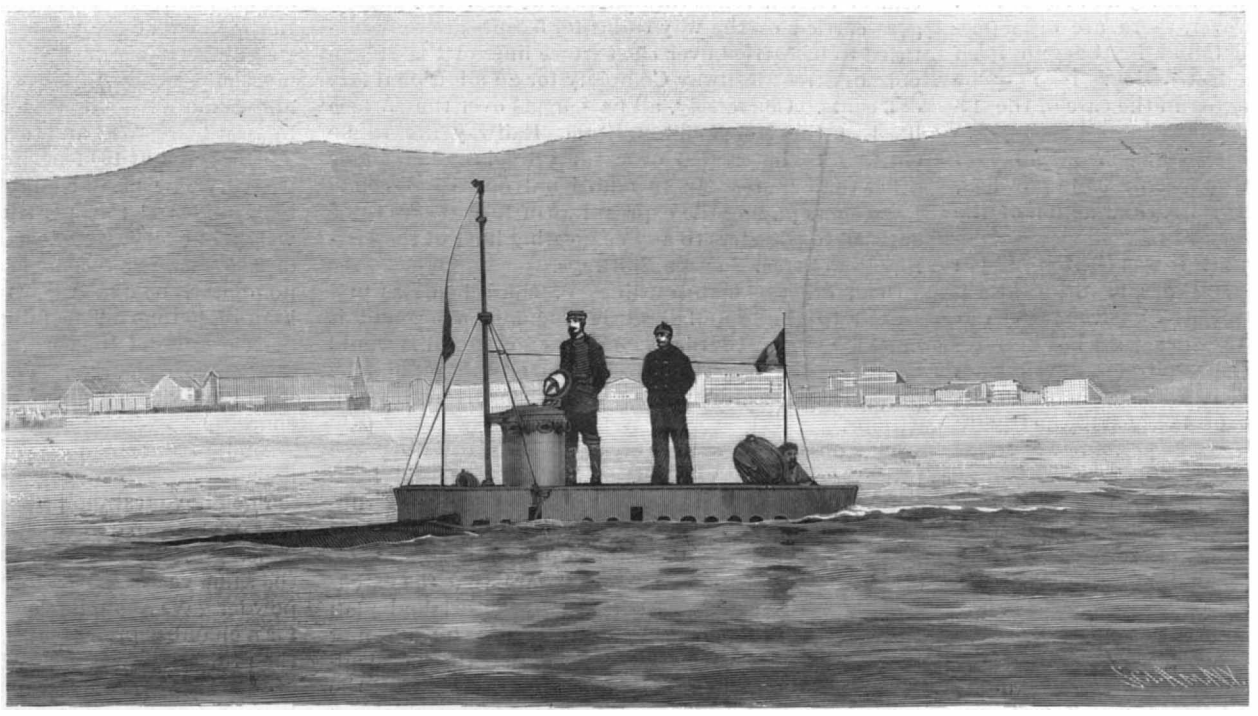
## FRENCH SUBMARINE TORPEDO BOATS.

The widespread interest which has been aroused by the performances of the submarine torpedo boat "Gustave Zédé" (so named after the late inventor) is out of all proportion to the actual fighting value of this type of vessel; for, although she is probably the most successful and practical vessel of the type that has yet appeared, she has done nothing to warrant the unbounded enthusiasm with which the French people have greeted her appearance—a fact which has been pointed out by some of the most noted experts of the French navy.

However, there is evidently something which takes the popular fancy in the idea of a fighting ship that can move unseen in the depths of the ocean, and strike a fatal blow unnoticed and unsuspected by the enemy. The "Gustave Zédé" has proved her ability to travel at a moderate speed at the surface of the water; she has also shown that she can dive and proceed at a greatly reduced speed below the surface; but it has yet to be shown that she can overtake a modern warship, sink below the water, keeping still in touch with her foe, and then deliver the fatal blow unerringly. In this, as in all other vessels of the class, the weak point is the impossibility of keeping in sight a ship that is on the alert and in full command of her maneuvering powers. At the same time, as is pointed out by the naval officer quoted at the close of this article, there will probably be a sphere of usefulness for the submarine vessel in assisting in the defense of a blockaded harbor. For this class of work it will rank with the torpedo and the submarine mine.



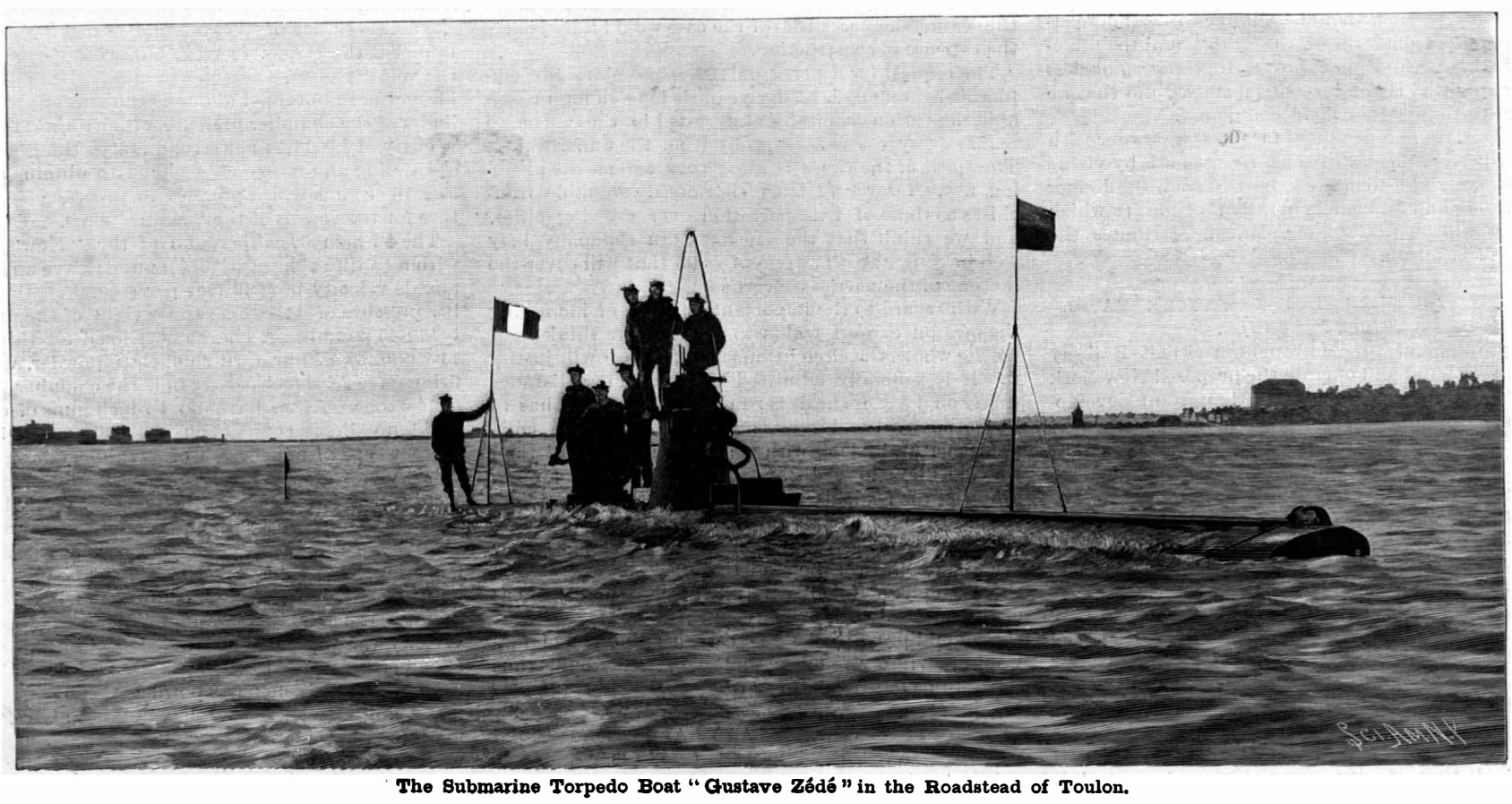
The "Gymnote" Rising After Submersion.



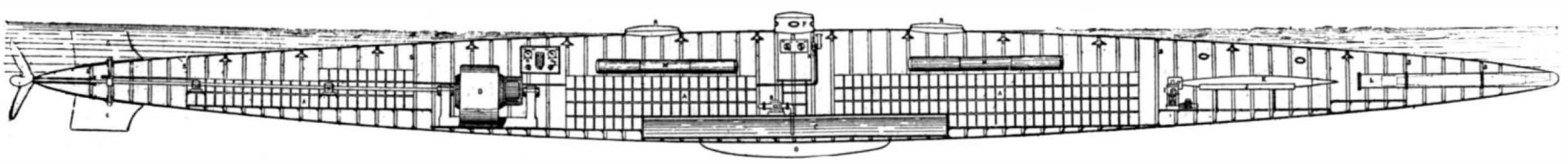
The "Gymnote" Traveling at the Surface.

The first of the submarine boats built by Engineer Zédé was commenced at Toulon in 1886. She was named the "Gymnote," and was considered as a mere experimental vessel on which to test the principal problems connected with this type of warship; such, for instance, as those of submersion, steering, visibility, and habitability. The "Gymnote" was to all intents and purposes nothing more than a large Whitehead torpedo, 56·7 feet in length and 5·9 feet in diameter, and with a displacement of about 30 tons It was provided with horizontal rudders to enable it to dive, maintain its desired depth below water, and rise again to the surface. It was built of steel and was driven by an electric motor of 55 horse power, the current being supplied from storage batteries. Its speed was about 7 knots submerged, and about 9 knots when traveling at the surface of the water. The storage batteries were sufficient to run the vessel for four or five hours. Buoyancy was secured by means of watertight compartments placed fore and aft; sufficient air was stored in convenient positions within the boat to give the necessary air for the respiration of a crew of four or five men when the boat was submerged. Attached below the hull was a certain amount of ballast, which, if desired, could be released from the inside of the vessel, thereby allowing the latter

(Continued on p. 217.)



The Submarine Torpedo Boat "Gustave Zédé" in the Roadstead of Toulon.



**Longitudinal Section Through the "Gustave Zédé."**

Length, 148 feet; diameter, 10·75 feet; displacement, 260 tons; propulsion by a 750 H. P. electric motor; submersion through the introduction of water and the use of a horizontal rudder.
*A*, accumulators; *B*, submersion pump; *C*, submersion chamber; *D*, electric motor; *E*, switchboard; *G*, rudders; *H*, steering wheel; *J*, torpedo support; *K*, torpedo; *L*, torpedo tube; *M*, air reservoirs; *P*, conning tower; *R*, hatchways; *S*, water-tight bulkheads.

**FRENCH SUBMARINE TORPEDO BOATS.**

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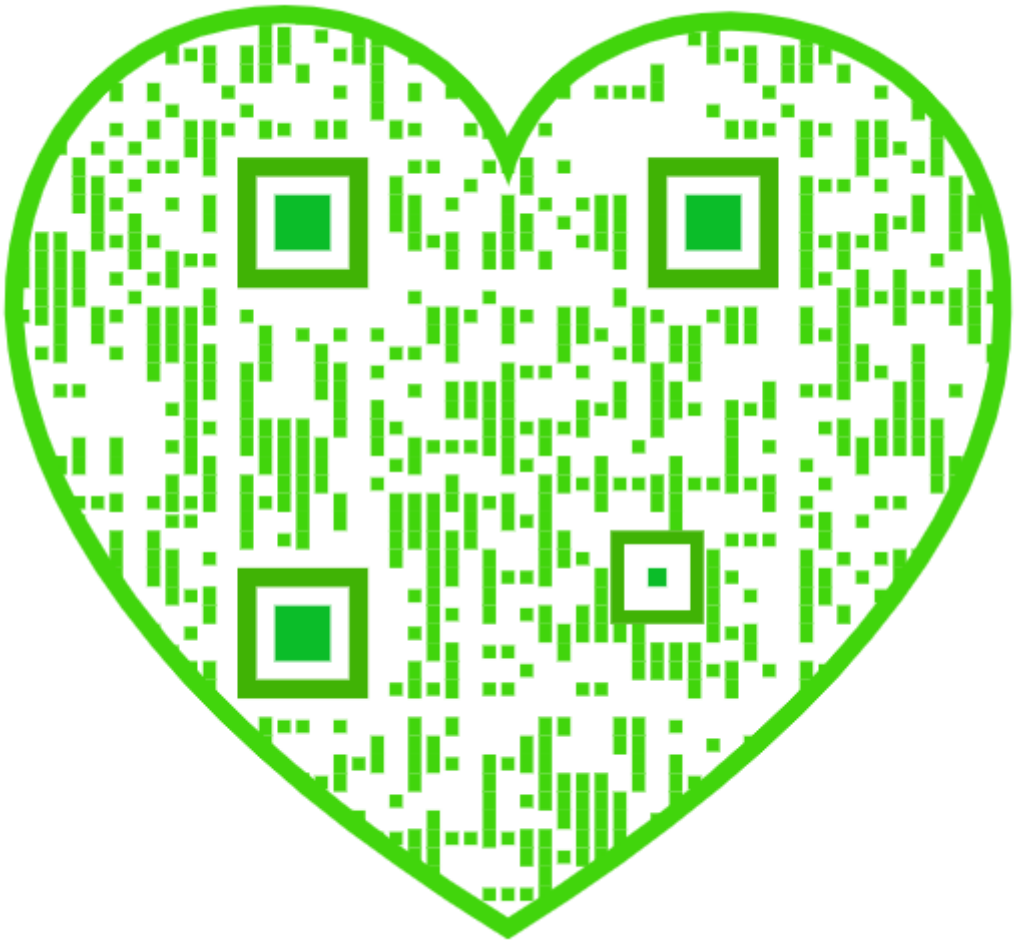

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## THE RECENT EXPLOSION OF A TEN-INCH ARMY GUN.

After the brilliant record of the Ordnance Department in the construction and testing of built-up guns, extending over many years, the recent bursting of an army 10-inch breech-loading rifle will come as a painful surprise to the general public. It has always been the boast of our ordnance officers that the great care exercised in the design and manufacture of our guns has resulted in the production of weapons that were not surpassed in respect of their accuracy and endurance.

As a matter of fact, however, there are other elements besides those to be found in the gun itself which may conduce to its destruction. It may be burst through faulty loading, as in the case of the 12-inch muzzle-loading gun of the "Thunderer," where two charges were put in by mistake, or in these days of nitro-glycerine and guncotton (smokeless) powders, the gun may be burst by the irregular action of the powder itself.

There is strong evidence that it was the too sudden combustion of the smokeless powder, resulting in abnormal pressures, that caused the disastrous wreck at Sandy Hook, for one of the pressure gages has been recovered which shows that the powder developed a pressure of 36 tons, or nearly two and a half times as great as the allowable limit of 15 tons to the square inch, while it is likely that even this pressure was greatly exceeded.

Mr. Hudson Maxim, who conjointly with Dr. Schupphaus is the inventor of the perforated smokeless powder used by the army and navy, contributes an article, which will be found on another page, in which he explains the probable cause of the explosion. The discussion is of great interest as coming from the inventor of the powder, and in the absence of any evidence of other causes will probably be accepted as the true explanation. That the army powder, which was supposed to be particularly safe because of its low percentage of nitroglycerine, should be liable to semi-detonation, because of the form of the grains and the direction of the perforations, proves that the smokeless powder question is still in its trial stages, and that we have yet to produce the ideal compound.

It is a curious and pertinent fact that a powder with a higher percentage of nitroglycerine would, by virtue of its elasticity and toughness, be free from the danger of shattering and sudden generation of gas, to which causes, it will be noticed, Mr. Maxim attributes the explosion of the gun.

## PROPOSAL TO BUILD THE NEW YORK RAPID TRANSIT TUNNEL.

The proposal of the Metropolitan Street Railway Company to build and operate the proposed New York Rapid Transit Tunnel is the most important development in connection with this great scheme since it first received legislative sanction. The public is familiar with the history of the hitherto abortive attempts, extending over a period of many years, to secure the necessary funds (about $30,000,000) and start the work of active construction. After surmounting a host of legal difficulties, the Board of Rapid Transit Commissioners found themselves face to face with the fact that New York was prevented by its charter from incurring the additional debt which would be necessary if the road was to be constructed at the city's expense. For some time it has been evident that if the work is to be undertaken at all, it must be done by private capital, and while, for obvious reasons, it is desirable that the road should be built and owned by the city, it is realized that if city ownership and control is made a *sine qua non*, this greatly needed improvement will have to be indefinitely postponed.

At this juncture the Metropolitan Street Railway Company has come forward with a proposition which, while not altogether free from objectionable features, is yet on the whole a fair proposal and contains many features to recommend it to the favorable consideration of the people and the people's representatives, the Rapid Transit Commission.

Briefly stated, the proposal is as follows: A combination of capitalists who are largely interested in the Metropolitan Street Railway Company propose to construct an underground railway according to the plans of the commission and lease it in perpetuity to the Metropolitan Street Railway Company. It is proposed that a company be organized to build the tunnel, work to begin on the first section, from City Hall to Fort George, within three months after the right is acquired and to be completed within three years' time. As soon as the first section has proved that it can earn 5 per cent on the cost of construction and equipment, the second section, extending from One Hundred and Fourth Street to the Bronx, will be built. On its completion the road is to be leased by the Construction Company in perpetuity to the Metropolitan Street Railway Company for a yearly rental of 5 per cent of its actual cost. The Metropolitan Company is to pay to the city 5 per cent of the gross receipts of the road after the taxes and the rental to the Construction Company have been paid.

As regards the operation of the road, the Metropolitan Company will pledge itself to run express trains, charging a fare of 10 cents, these trains to run at a rate of 20 miles an hour below Ninety-sixth Street, and for at least 2 miles below Forty-second Street at the rate of 30 miles an hour. The fare on all trains, except the express, to be 5 cents.

A most important provision—one which above all others commends this proposal to favorable consideration—is the proposal of the Metropolitan Company to operate the new tunnel road as part of their great system of electric roads throughout the city. All passengers carried on the way trains for 5 cents are to be entitled to be carried over the surface lines of the Metropolitan Street Railway Company for an additional fare of 3 cents. Conversely, all passengers over the surface lines of the Metropolitan Street Railway are to be entitled to be carried over the tunnel road on trains other than express for an additional fare of 3 cents. Passengers paying the express fare of 10 cents are to be entitled to transfers to any connecting lines of the Metropolitan Street Surface Railways.

Such are the main outlines of the scheme as presented to the Rapid Transit Commissioners, and it must be confessed that as matters now stand it would be wise policy on the part of the city to accept the proposition, subject to one or two important modifications.

The objectionable features, it seems to us, are the proposals that the city shall grant a perpetual franchise and the fact that the proposed line of the tunnel is incomplete to the extent that it will terminate at the City Hall instead of running, as it should do, down to the Battery. We are aware that the extension to the Battery was cut out of the original plan because of the difficulties of construction, but nothing has been brought forward to prove that those difficulties are insuperable; and in view of the fact that the most important business interests of the city are centered nearly a mile south of City Hall Park, we think that the necessities of the case would fully justify the expense of construction.

The request for a perpetual franchise should be emphatically opposed. Fifty years is long enough to enable the various capitalists interested in the scheme to realize every reasonable profit from the undertaking. The spirit of the times is altogether against the pledging away forever of such enormously valuable franchises as those of transportation over growing cities, and we think that the Metropolitan Company may well be content with a term of years that will cover the lifetime of the parties concerned.

With regard to the important question of increasing the fare on express trains to 10 cents, we think that, on the whole, the circumstances of the case will justify it. It is generally admitted that the long distance travel on a 5 cents basis is run at a loss which has to be borne by the local traffic. Transportation companies naturally look with more favor upon local than they do upon long distance travel, and, therefore, in granting the franchise, particular care should be taken to specify that a certain number of express trains must be run daily in each direction. It is possible that at the first opening of the road the working classes and those who have to look carefully at the smaller items of their daily expense will avoid the 10 cent train. If this should prove to be the case, a reduction of fare would inevitably follow, and the matter would thus prove to be self-regulating.

## UNITED STATES NAVY AND ARMSTRONG GUNS AT THE PROVING GROUNDS.

A curiously perverted account of some tests recently carried out at the naval proving grounds has been going the round of the daily press. The story relates that, in consequence of some boastful remarks made by the British naval attaché at Washington to the effect that the Armstrong guns on the "New Orleans" are greatly superior to the United States weapons, the government determined to subject each type to a comparative trial under similar conditions, and accordingly two guns on the "New Orleans" were sent to Indian Head, where they failed under test to come anywhere near the record of the home-made weapons.

As a matter of fact, the United States naval experts are too seriously preoccupied in the work of turning out the very best possible weapons according to their own theories and methods of construction to waste time in any pyrotechnic displays for the benefit of the general press. The bureau finds sufficient satisfaction in the excellent record which it has made in working along its own independent lines, a satisfaction which is not measured by the ability of its guns to "beat" this or that particular make of some foreign power. The naval attaché, moreover, never made any such invidious comparison—the gentlemen who hold such positions being too well grounded in the precepts of good breeding to be guilty of such an obvious breach of professional etiquette.

The facts of the case regarding these tests are as follows: It being desired to determine what charges of our own smokeless powder for the "New Orleans" guns would give the same muzzle velocity, and, therefore, the same energy, as the English cordite, two of her guns, a 6-inch and a 4·7-inch, with some of their own English service ammunition, were sent to Indian Head, not for the purpose of making comparative tests with our own guns (though incidentally, of course, the results obtained with the two types were compared), but in order to determine what weight of our own powder must be put into the cartridges, which will henceforth be supplied from our factories, instead of from England.

The "New Orleans" guns are fifty calibers long, and are supplied with cordite charges. For the 6-inch gun the weight of charge is 18·65 pounds, the projectile weighing, like our own, 100 pounds. The average muzzle velocity obtained with three rounds of the above ammunition was 2,528 feet per second, the highest being 2,554 and the lowest 2,504 feet per second. This was about 100 feet per second less than was expected. The mean chamber pressure, however, was a trifle under 14 tons per square inch; therefore, if the weight of charge were increased somewhat, the velocity of 2,650 feet per second claimed by Armstrong could, no doubt, be realized without exceeding the usual limit of 15 tons. The falling off was probably due to deterioration of the cordite, resulting from climatic or temperature changes. The same gun was then loaded with a heavier charge of our own smokeless powder, a charge of 26 pounds giving a velocity of 2,576 feet per second, with a chamber pressure of 14·8 tons per square inch.

The above test took place in December of last year, and was compared with the firing of a 40-caliber 6-inch gun of our make, which took place in June of the same year. This gun with 31 pounds of smokeless powder gave a muzzle velocity of 2,601 feet per second for a chamber pressure of 15 tons to the square inch; the projectile weighing 100 pounds, or the same as that of the Armstrong gun. In the article to which we have referred, and which was so universally disseminated through the daily press, it was stated that a muzzle velocity of 3,000 feet per second had been obtained at the December trial, but, as a matter of fact, the velocity of 2,601 feet per second is the highest that has yet been obtained in our 40-caliber guns within the limits of the chamber pressure of 15 tons. This high velocity of 3,000 feet per second is something which we are aiming at, and which we hope to obtain with the 50-caliber guns which are now in process of manufacture for the vessels of the "Maine" class.

The 4·7-inch 50-caliber gun of the "New Orleans" with a cordite charge of 8½ pounds gave an average muzzle velocity of 2,549 feet per second, with a chamber pressure of 14·4 tons; the weight of the projectile being 45 pounds. A charge was fixed for this gun of 13·5 pounds of our own smokeless powder, which on firing gave 2,606 feet per second, the chamber pressure of 14·6 tons. As we have no 4·7-inch guns of our own build, no direct comparison could be made, but our present type of 5-inch gun of 40 calibers has a muzzle velocity of 2,725 feet per second, using a 50-pound projectile. This projectile, however, is relatively light for the caliber and would tend, therefore, to increase the velocity. In the new guns which we are now manufacturing, the projectile will weigh 55 pounds and the gun will be 50 instead of 40 calibers in length. No attempt was made to determine the maximum muzzle velocity that could be obtained within the allowed chamber pressure from the "New Orleans" when using our own smokeless powder, the object of the test being merely, as we have stated above, to determine what increased weight of our own powder would be necessary to give the same velocity as the stronger cordite powder which was supplied with the gun.

It will be noticed that it required about fifty per cent more of our navy powder by weight to give approximately the same velocity as was secured by the cordite. This is explained by the fact that the cordite has greater strength weight for weight due to the large percentage of nitroglycerine employed in its manufacture. Our navy powder is composed almost entirely of guncotton, which is preferred by the ordnance authority, since it has been considered more reliable and safer than the high nitroglycerine compounds.

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### ELECTRICITY AT HIGH PRESSURES.

Prof. Elihu Thomson, of Lynn, Mass., gave an entertaining lecture on the above subject on March 29, before the New York Electrical Society, at the house of the American Society of Civil Engineers, in this city, and exhibited a new form of apparatus which was very effective in producing electricity of a high potential. He described how, years ago, he became interested in frictional electric machines; how, as a boy, the frictional electrical phenomena attracted his attention; and explained how the apparently inert electricity bound on the surface of a sheet of hard rubber is made to manifest itself by rubbing the surface with fur or silk. This peculiarity was still more marked by coating a smooth dielectric plate with varnish, letting the varnish dry, then stripping it from the plate. This film, in the act of being stripped, becomes electrified, disturbing the electricity bound on the surface of the plate.

The principle of the influence electrical machine was the same, only on a larger scale, the breaking of the cleavage being continuous. He described the hydro-steam method of accumulating electricity of high potentials, and showed that it was due to the friction of an aggregation of globules acting on one another. This led up to an explanation of the production of electricity in thunderstorms, wherein the circular forms of clouds, known as thunderheads, collect, and intensify their electrical tension much in the same way. They being of one electrical polarity discharge with high pressure to the earth or other clouds of horizontal formation of the opposite polarity.

The estimated voltage of a lightning discharge was from twenty to fifty million volts. Influence machines have come into much request since the X-ray discovery. A Prof. Williams, of Boston, had constructed one, the glass disks of which were 6 feet in diameter, and produced a spark 7 feet long. Using this machine in connection with an X ray tube, physicians were able, in an examination of the lungs, to detect the presence of the pneumonia microbes before any symptoms of that disease were felt or were indicated by the patient, and X-ray photographs could be taken in a fraction of the time ordinarily required.

The utility of high pressure currents was in the saving of copper in transmission lines; and as the price of copper was advancing, means for controlling and securing the most economical results in the use and disposal of such currents demanded the attention and consideration of electricians. Up to the present time it was practical to transmit high pressure currents a distance of 83 miles, using a pressure of 50,000 volts. If a voltage higher than that was used, the electricity would escape from the wires into the air in the form of small, luminous blue flames. If a conductor is put within two inches of such highly charged wires, a discharge will take place. These peculiarities of high pressure currents make it difficult to control and measure them. He described a special form of meter for measuring such currents.

He exhibited and explained a new form of induction coil for producing currents of high tension. It consisted of an inner copper cylinder having parallel glass tubes about a quarter of an inch in diameter longitudinally on the surface. Over this is wound the fine wire of a secondary coil in one layer, the ends being duly insulated at one end. The wire is thus insulated from the metal cylinder. The secondary coil and cylinder are then set on end into a glass jar containing oil. A primary coil of coarse copper wire, having a diameter of about one inch larger than the interior secondary coil, is next set into the jar surrounding the secondary coil. The oil insulates the two coils, and this Prof. Thomson found was very effective in using heavy currents.

One of the most interesting experiments of the evening was the exhibition of the new "Wehnelt Electrolytic Interrupter," invented by Dr. A. Wehnelt, of Charlottenburg, Germany, and how it may be utilized. The interrupter is inserted in the primary circuit of an induction coil, no condenser being needed in the latter. Briefly, it is made by suspending in an electrolyte solution a platinum wire, all except a half inch of which is insulated from contact with the solution, and a lead plate about a half inch or more below the platinum anode; one wire is carried to the platinum wire and the other to the lead plate.

When the current from a strong battery or one of 110 volts is sent through the primary circuit, immediately a peculiar high-pitched hissing sound is noticed coming from the glass jar holding the interrupter, and soon a peculiar-looking electric flame flows between the ball terminals of the secondary coil. It is evidently an interrupter of high frequency and remarkably simple. The theory of its action was explained as follows: On closing the primary circuit, a film of gas is formed at the platinum terminal, enveloping it like a wall, which breaks its contact with the electrolyte fluid; the gas then escapes, contact again occurs and vibrations of wonderful frequency continue.

By another arrangement, he was able to vary the strength of the current and produce different sound notes, enough to indicate a tune. Still another application was the placing of a coreless electro-magnet in the center of a wood resonator in the form of a box.

The closing of the primary circuit caused this magnet, located in the secondary circuit, to vibrate rapidly the back of the resonator, and produce a sound almost as intense as a whistle. Prof. Thomson suggested that with a contrivance of this character the usual compressed air whistle of the present electric cars could be dispensed with. The audience was very enthusiastic over these experiments. His last experiment illustrated a combination of electrical machines or features by which a low voltage of 60 volts was intensified to several thousand volts. A motor dynamo was operated by the usual 110 volt current; this produced an alternating current of 60 volts, which went into a step-up transformer, and from that the higher induced current was led to a series of vertical Planté condensers. Under these was a revolving frame rotating with the speed of the motor which alternately put the condenser plates in series or parallel.

This frame came within a quarter of an inch of the lower ends of the condenser plates. The induced current was highly intensified as a consequence, and sparks two feet long were readily obtained. He remarked that it was a sort of "multum in parvo" arrangement for the lecture room, and by it he was able to secure the same results as if 1,000 storage battery cells had been used. It was the very latest device of the kind he had built. Altogether the lecture was highly instructive and interesting.

### DEATH OF GENERAL FLAGLER.

Brigadier-General Daniel W. Flagler, Chief of Ordnance, United States Army, died at Old Point Comfort on March 29. He was born in New York in 1835 and graduated from West Point in 1861. He entered the army as a second lieutenant and served during the Civil War, first in drilling volunteers at Washington and then with the Ordnance Department. He became Assistant Ordnance Officer at the Alleghany Arsenal; later he became Inspector of Ordnance in fitting out the Mississippi River flotilla and Chief of Ordnance to General Burnside's expedition to North Carolina. He had charge of the transportation of siege guns and occupied other positions, such as inspector at the West Point foundry and as assistant to the Chief of Ordnance. His services were not altogether in the foundry and office, for he took part in the battles at Bull Run, Roanoke Island, New Berne, Fort Macon, Summit Mountain, Antietam, Fredericksburg, Chancellorsville, and Gettysburg. At the close of the war he was breveted Lieutenant-Colonel for distinguished services in the field. After the war was finished he made a tour of inspection of the Western arsenals with the Chief of Ordnance. He held important positions in various arsenals and armories until he was appointed Brigadier-General and Chief of Ordnance on January 23, 1891. He was regarded as one of the greatest ordnance experts in the country, and the reports of the Chief of Ordnance which were issued by his bureau are most valuable reference books. The army has suffered a distinct loss in the death of General Flagler.

### THE AUDUBON SOCIETY.

The annual meeting of the Audubon Society of New York State was held in the lecture room of the American Museum of Natural History on March 23. An illustrated lecture on birds was given by Prof. A. S. Bickmore, and in the absence of President Morris K. Jesup, Mr. Frank M. Chapman, chairman of the executive committee, presided. An interesting letter was read from Governor Roosevelt, in which he stated that he sympathized with the purpose of the society, saying that he did not understand how any man or woman can fail to try to exert all influence in support of such objects as those of the Audubon Society. He said in conclusion, "When I hear of the destruction of a species I feel just as if all the works of some great writer had perished, as if we had lost all instead of only a part of Polybius or Livy." Rev. Dr. Henry Van Dyke sent a letter, in which he said the sight of an aigrette filled him with a feeling of indignation, and pity at the skin of a dead song bird stuck on the head of tuneless women made him hate the barbarism which lingers in our so-called civilization. The great singer Madam Lili Lehmann was introduced as a distinguished and loyal friend of birds, and she made an excellent address which was very much to the point. She said that in Europe there were many societies for the protection of birds, and they all worked in harmony, and any person could become a member of those societies upon the payment of a nominal sum, equivalent to two or three cents, the main purpose being to enlist all kinds of people in the movement for the protection of birds. She said that she was sorry to learn that there were no places in Central Park expressly for the purpose of feeding birds. She had eight such places in her garden where the birds may come and be fed. She said there were 25,000,000 useful birds slaughtered annually for use on women's bonnets, and that farmers were already suffering from it and that "women enjoy wearing feathers like savages." Flowers and ribbons were a thousand times more beautiful and more becoming. It is the duty of every woman to battle against this grewsome folly. For years Madam Lehmann's hats have not had feathers. Mr. Chapman stated that the widespread use of the quills of the brown pelican for hat trimmings was fast bringing about the extinction of that species.

### SOME NEW KITE EXPERIMENTS AT BAYONNE.

Mr. W. A. Eddy, of Bayonne, N. J., has recently tried some interesting kite experiments, and on March 25, at 4 P. M., he made partly ready a hot air balloon for an ascension, but the wind and snow increased so rapidly that the air pressure on the side of the partly inflated balloon broke the pole which was being held in position, so that the balloon experiments with an electric wire and Leyden jar had to be deferred. The cost of the balloon is defrayed by the Hodgson fund of the Smithsonian Institution, and its purchase was authorized by Prof. S. P. Langley, secretary of the Institution. A kite-sustained thermometer was sent up at 5:10 P. M., however, notwithstanding the mingled snow and rain. It was finally hauled down at 7:45 P. M., a test of temperature being made at heights of 200, 400 and 600 feet. The air at the 600 foot level was found to be 28° above zero as compared with 31° above zero at the earth. At 200 feet the air was found to be 1° warmer than at the earth. The experiments demonstrated that during mingled rain and snow there is an intermediate layer of warm air a short distance aloft, but higher up it is colder. The coolness was greater than the normal, indicating cooler weather.

### TESTS OF WIRELESS TELEGRAPHY.

Signor G. Marconi, the inventor who recently obtained permission from the French government to establish a station on the French coast for the purpose of experimenting with wireless telegraphy between England and France, announces that he has conducted successful experiments between South Foreland, in Kent, and Wimereux, near Boulogne, France, the distance being thirty-two miles. Thus far the experiments have been highly successful and the messages have passed with ease. Signor Marconi personally superintended the test. The London Times received the first wireless press message across the Channel. The Morse code was used. The French government officials, who have been watching the experiments, have been very favorably impressed. The messages received were read at the South Foreland Lighthouse with no more difficulty than those transmitted by cable. In the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1213, there is an important paper by Signor Marconi which gives some of the latest results of his experiments.

### FOREIGN EXHIBITIONS OF 1899.

Usually the year before and after a great international exposition there are a number of smaller expositions. This is the case in the present year, and will also be the case in 1901. There will be an exposition in Western Australia, at Coolgardie, beginning in March, and intercolonial in character. On June 14, the Provincial Exposition of East Flanders will be held at Ghent. There will also be a department for foreign exhibits. The International Electrical Exposition and Congress of Electricians will be held at Como next summer, in honor of the birth of Alessandro Volta, the discoverer of the electric battery. The exposition will commence on May 15 and will continue until October 15.

### CONGRESS OF LIFE INSURANCE DOCTORS IN BELGIUM.

The first international congress of doctors connected with life insurance will be held at Brussels from September 25 to 30, 1899. There will be representatives from all over Europe and the United States. It is proposed to establish universal formulas for the examination of persons desiring to be insured. As a result of the congress, it is hoped that permanent offices will be created in every country, composed of five medical members, who will see that the decisions of the congress are strictly observed.

### AN UNDER-TROLLEY CAR BURNS UP.

A Sixth Avenue electric trolley car caught fire on March 28, in the Fiftieth Street car house of the Metropolitan Street Railway. The current had been shut off when the car was run into the car house, but the plow was still connected with the current, and this is supposed to have caused the fire. An alarm was turned in and Battalion Chief Binns, who was the first man to get aboard the car, received so severe a shock that he was unable to continue directing the work of putting out the fire.

### SPAIN'S NEW CRUISER.

The cruiser "Rio de la Plata," the money for whose construction was subscribed by the Spaniards of South American countries, has been completed at Havre and will shortly be delivered to the Spanish government.

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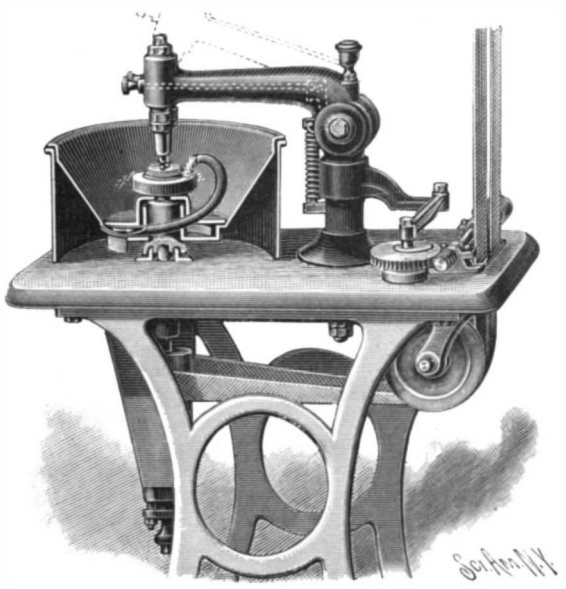
### AN IMPROVED LENS-GRINDING MACHINE.

A novel grinding-machine has been invented and patented by Davilla S. Thomson, of Livermore Falls, Me., which is especially designed for the use of manufacturing opticians, and which is characterized by simplicity of construction and automaticity of operation. The machine comprises, essentially, lens-holding devices, a centrifugal pump for the supply of abrading material, and a grinding mechanism, all these parts being driven from a common source of power. The lens-holding devices consist of a vertical shaft carrying at its upper extremity an abrading disk upon which the lens to be ground is placed. The disk is rotated



THOMSON'S LENS-GRINDING MACHINE.

by means of a belt and pulley driven by a power-shaft at one end of the machine. On the shaft which carries the disk the centrifugal pump is arranged, the propeller-wheel of which revolves in a casing formed on the lower end of a pan in which the grinding material is contained. This material, by means of the centrifugal pump, is forced from the pan to the lens through a coiled pipe, as the shaft carrying the disk rotates. The grinding-mechanism consists of a vertical spindle carrying a pivoted yoke at its upper end. Each arm of the yoke is provided at its outer end with a carrier containing a shanked ball, which is held in engagement with the lens by means of a spring. Each arm can be raised, if desired, as shown by dotted lines in the figure, and can be held in this inactive position. In order to grind the lens, the vertical spindle carrying the yoke is rocked by means of a rock-arm actuated by a worm-wheel engaging a worm on the power-shaft previously mentioned. The worm-wheel has an eccentrically-placed hole in which a disk carrying a crank-pin is adjustable. By regulating the position of the disk, the throw of the spindle, and therefore that of the arms and carrier balls, can be increased or decreased. When the power-shaft is in operation, the lens-holding disk will be rotated, the pump will force the abrading material upon the lens, and the carrier-balls will be rocked so as to grind the lens as it rotates.

### A Word of Advice.

O'Hoolahan (disgustedly).—The boss's goin' to give me a dom automobile truck to drive instead of the team, Norah.

Norah.—Well, what of it?

O'Hoolahan.—"What of it?" Will, Oi'll have to subscribe to the Scientific American, so's to know how to swear at the dom thing!—From Puck.

### POWERFUL FREIGHT LOCOMOTIVE FOR THE PENNSYLVANIA RAILROAD.

The Pennsylvania Railroad has for many years enjoyed the distinction of being considered by European engineers, and by not a few in America, the model railroad of the United States. It is supposed by Englishmen to hold, in respect of its roadbed and equipment, the same representative position accorded to the London and Northwestern in Great Britain.

While it is undoubtedly true that the reputation of these two roads has been well earned, and that twenty or thirty years ago they were easily first in their respective countries, it is probable that there are now other roads which equal them in most, if not all, points of comparison. This fact, however, does not detract from the great credit which is due to them, and particularly to the Pennsylvania Railroad, for having inaugurated many improvements, which other roads, following their lead, subsequently adopted.

To the Pennsylvania system is largely due the vast improvement which has taken place in the past fifteen or twenty years in roadbed and track, and their heavy rail sections and rock-ballasted and thoroughly drained roadbed were for some years the standard for other roads to follow. They were early in the field in the introduction of an adequate system of signals, and they were, we believe, the first company to introduce the old country practice of beautifying the station grounds and sodding and keeping in trim order the slopes of excavations and embankments.

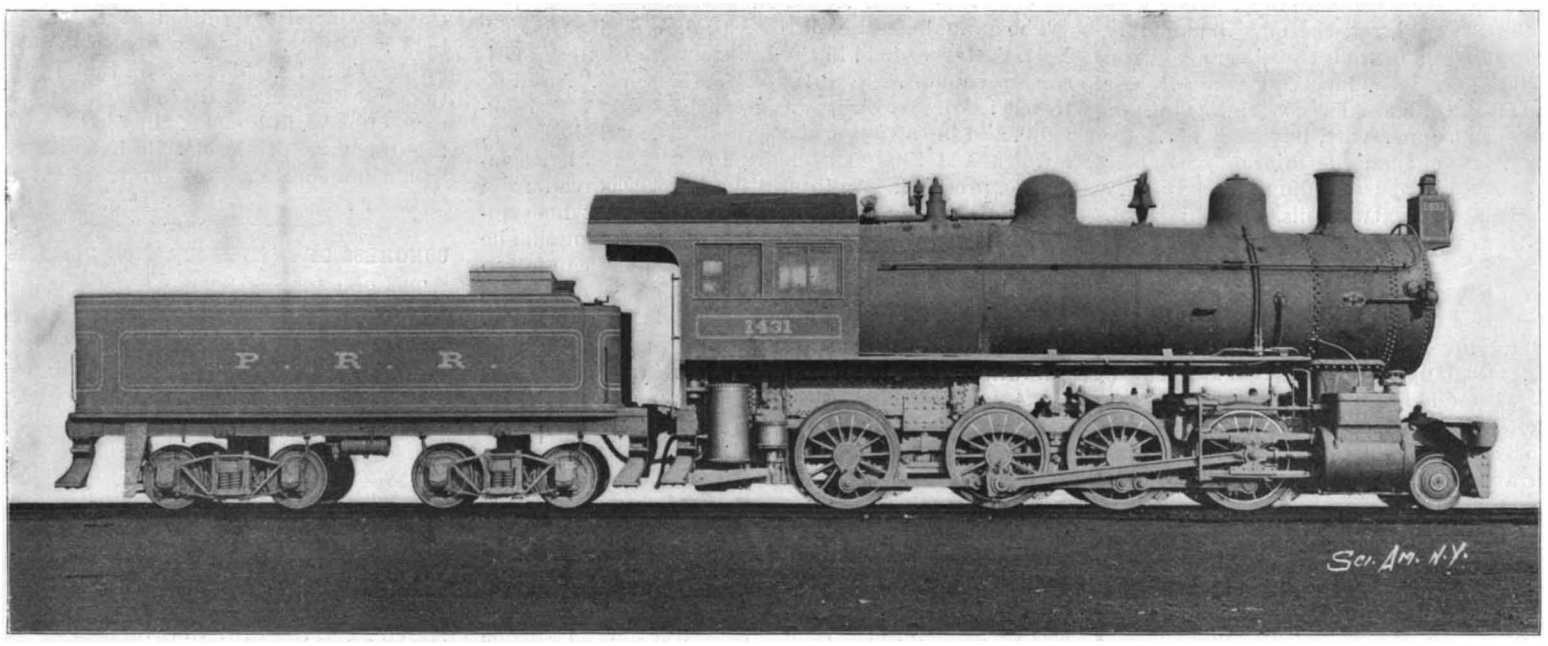
In the matter of motive power and rolling stock the road has always been fully abreast of the best American practice, and in some respects has led the way; the "Chicago Limited" being at the first, perhaps, the most sumptuously appointed train in the world, although to-day its counterpart can be found on more than one of the great systems of the United States.

The motive power of the Pennsylvania Railroad has always been marked by strong individual characteristics, and while the practice has been to adhere to a few fixed types and patterns of engines, a large amount of experimental work has been accomplished. It will be remembered that this company was first in the field in serious and protracted experiments with the compound system, one of Mr. Webb's three-cylinder express engines being imported from the London and Northwestern Railway for this purpose. The compound system, however, does not appear to have favorably impressed the master mechanics of the road, if we may judge from the small number of the type that are to be found in service.

We present an illustration of the most recent and most powerful of the freight locomotives which have been built by the company. Although it is surpassed somewhat in weight or power by two or three of the other big freight engines of recent construction, it is perhaps the most shapely and pleasing to the eye of any of them. It is of the simple, high pressure type, with two cylinders 23·5 inches in diameter by 28 inches stroke, and a steam pressure of 185 pounds to the square inch. The weight on the drivers is 186,000 pounds, which is only exceeded by the great Pittsburg consolidation, illustrated in the Scientific American of December 3, 1898, which has 208,000 pounds on the drivers. The total estimated weight of the locomotive in working order is 208,000 pounds, as against 230,000 pounds for the Pittsburg engine. The weight of the tender, loaded, is 104,600 pounds. The driving wheels are 56 inches in diameter.

These engines, which are known as Class H—5, are giving great satisfaction. On one occasion one of them hauled, from Altoona to Columbia, a distance of 161 miles, against a maximum grade of 12 feet, a coal train of 130 cars. The total length of the train was 3,877 feet; the cars weighed 1,520 tons and the lading 3,692 tons; the total load being 5,212 gross tons.

On another occasion it hauled from Columbia to Morrisville, a distance of 100 miles, against a maximum grade of 29 feet, a train of 60 cars. The weight of the cars was 743 tons; of the lading, 1,819 tons; and the total load 2,562 gross tons.

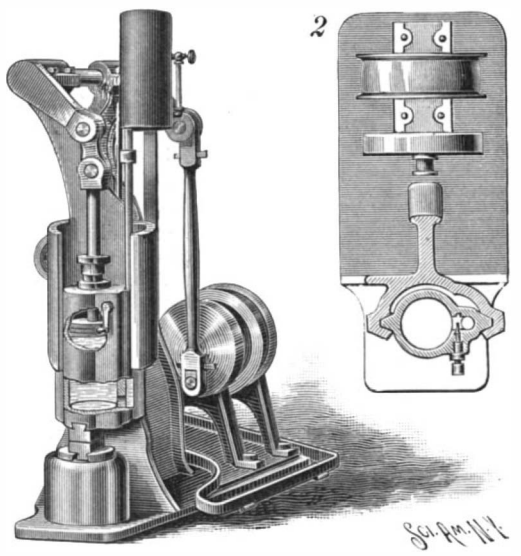



POWERFUL FREIGHT LOCOMOTIVE, PENNSYLVANIA RAILROAD.

Cylinders, 23½ × 28 inches; steam pressure, 185 pounds; weight on drivers, 186,000 pounds; total weight. 208,000 pounds.

### A NEW POWER-HAMMER.

In an invention patented by Andrew Dinkel, of Auburn, N. Y., an improved power-hammer or presser is



DINKEL'S POWER-HAMMER.

provided, by means of which a strong yet yielding blow may be given to the billet operated upon.

The accompanying engraving represents this new hammer in perspective and in section.

The hammer-head slides in vertical guides, and is provided with a die which coacts with another die on the anvil. Within the hammer-head are a main liquid-containing chamber and an auxiliary liquid-containing chamber, the two being connected by valved ports. Within the main chamber a piston moves, having a stem projecting from the chamber and connected at its upper end by means of a link with a rock-shaft operated from a driving-pulley through the medium of a rocker-arm and pitman. From the upper end of the auxiliary chamber a pipe projects, which passes in and out of a cylinder partially filled with some liquid, such as oil, a space being left to form an air-cushion. The pressure of this air-cushion may be regulated to the work in hand.

When the hammer-head is in its uppermost position, the work to be operated upon is placed upon the anvil. When the belt upon the driving-pulley has been tightened, the hammer will be forced down, thus causing a strong, yet yielding blow to be struck. After having descended, the hammer will remain stationary; but the piston in the main chamber of the hammer-head will continue to move down against the resistance of the air-cushion in the cylinder connected with the auxiliary chamber. By this means a strong pressure is brought to bear upon the work, in addition to the blow.

It will be observed from our engraving that the driving pulley and connected rotary parts are mounted in the base of the machine, whereby the sway and vibration which would be caused by placing tnese parts higher, is reduced to a minimum.

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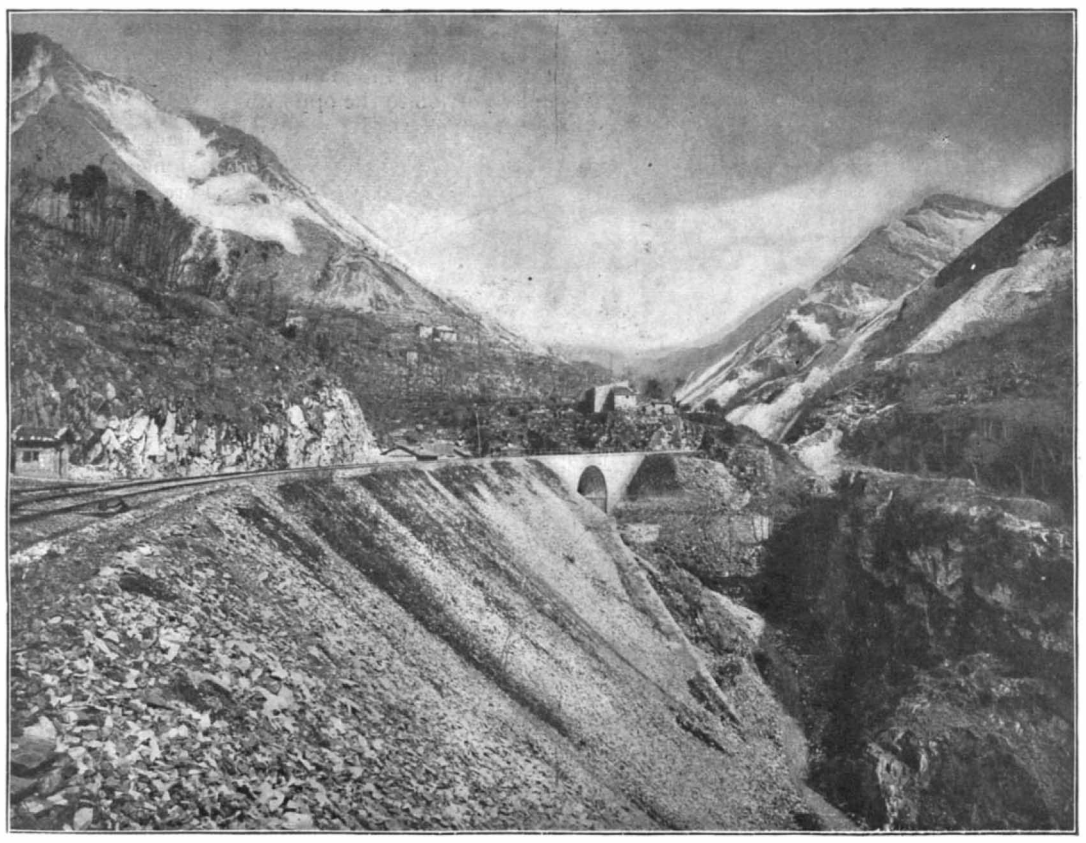
### CARRARA AND ITS QUARRIES.

Carrara marble is known throughout the world, yet few of the many tourists who are whirled along the Mediterranean Railway from Rome to Genoa ever stop to visit the spot from which this famous stone is obtained. Carrara lies on the railway between Pisa and Florence, and an excursion to the Carrara Mountains is not difficult. Carrara itself is hardly worth visiting, being simply an aggregation of homely houses on the banks of a muddy torrent at the base of the mountains. The mountains themselves can be seen even from the line of the Mediterranean Railway, the marble cropping out in numerous places. All the inhabitants of the little town are directly or indirectly interested in the quarrying, working, and shaping of the marble, and the glare of marble dust and marble meets one on every side. The marble quarries are entirely different from what might be expected, and in place of craning the neck to gaze down into the bowels of the earth, one only has to admire the long, irregular rift in the flank of the mountain, for the quarrying is all done on the surface and does not require the construction of pits or galleries. The quarries have been likened by one writer to a cascade of water suddenly hardened into stone.

The percentage of men who meet horrible deaths in the quarries is very large, notwithstanding the fact that powder and not dynamite is used. Of course many of these accidents are caused by carelessness on the part of the workmen, but these could, in nearly every case, be safeguarded against by proper appliances. When the great blocks are once detached, they either roll down the mountain or are lowered to the desired place by means of ropes and tackle. No machinery is employed, and all the work is done with the crudest appliances. A blast is announced by three long notes on a horn, but little attention seems to be paid to this signal by the workmen, and many terrible accidents result in consequence.

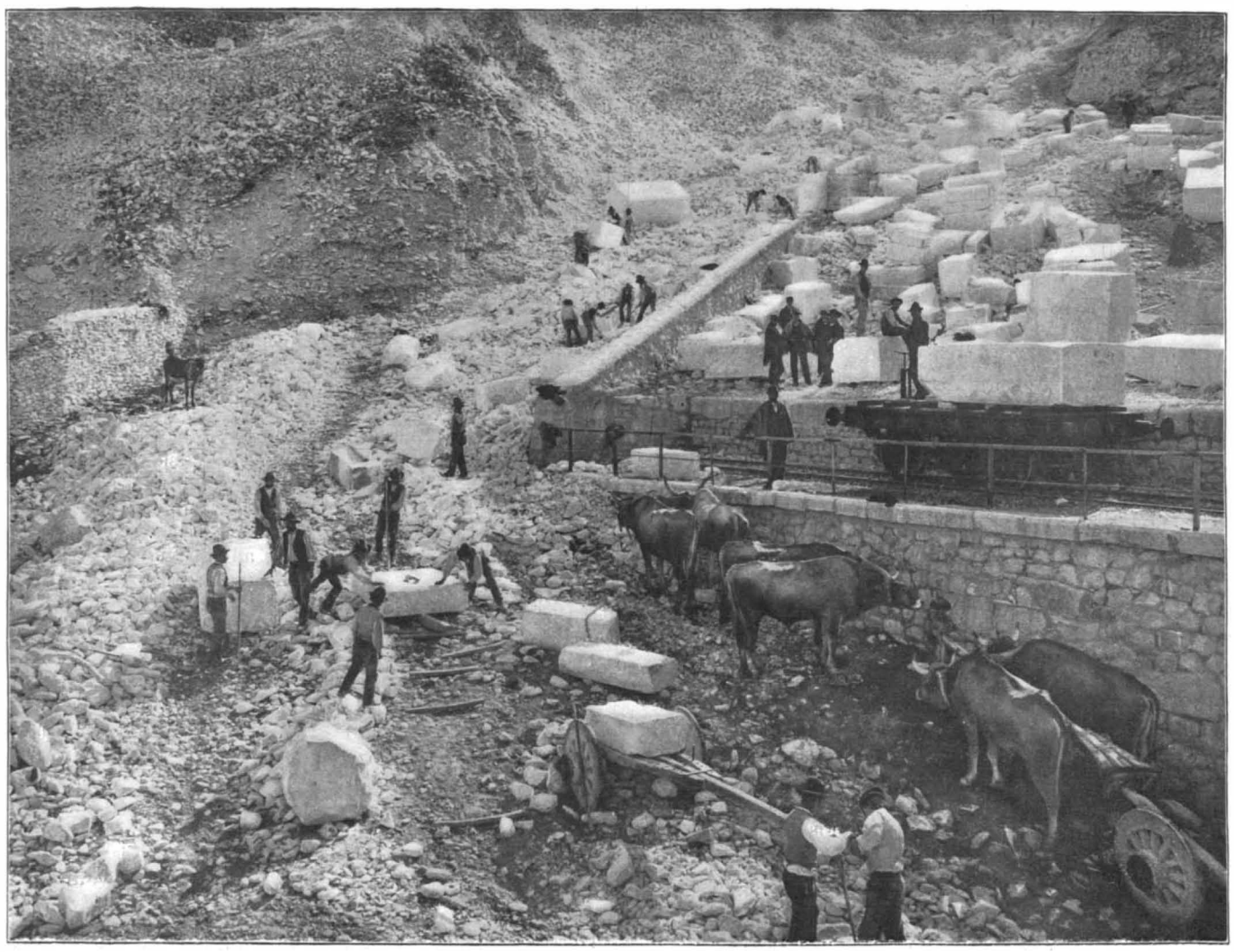
A few years back, when accidents occurred, the cathedral bells were tolled to give warning to the people; but owing to the anxiety and anguish of thousands of poor families on hearing this grewsome sound, the custom has now been abolished, and the workmen all leave the quarries as soon as an accident occurs, in order to assure their families of their safety, and they are allowed their full day's pay. The pay of the workmen is wretched, varying from sixty to eighty cents a day. A blast is very exciting to a stranger, who is usually accompanied by a guide, who contrives to get him in a place of absolute safety during the explosion. The marble is blasted high up on the peak, and the pieces bound or leap downward until they strike some obstruction or the valley below. Formerly all of the immense chunks of marble had to be transported by primitive carts hauled by oxen, but now the railway affords an easy means of transporting to the market, and one of our engravings shows the roughly shaped blocks being put on the ox carts and unloaded on the flat cars on the railway. The huge trucks are met everywhere floundering along, flinging great clouds of choking white dust in their train or splashing mud which is white in this remarkable locality. Each car is drawn by eighteen or twenty pairs of oxen which are covered with the white dust which is everywhere. They are goaded by their cruel drivers, for the Italians are notorious for their cruelty to animals.



THE CARRARA MOUNTAINS, SHOWING RAILWAY TO QUARRIES.

An interesting excursion is to one of the quarries which were worked by the Romans, and the quarries show how primitive were the means employed by men of antiquity. They first marked out the block upon the solid mass, and they actually cut it out by hand labor. In many places one can still see blocks which lie embedded in the rubbish caused in quarrying and shipping them. The Romans split their blocks into slabs by inserting wooden wedges and keeping them continually wet until the swelling of the wood burst asunder the stone. A Roman altar was unearthed some years ago near the quarries, and a few rusty implements have also been discovered.

The views from the mountain are superb. To the east lies Tuscany, and to the south, on a clear day, can be seen the blue coasts of Corsica and Sardinia. Carrara marble has been a favorite with sculptors for nearly two thousand years, and to-day it is nearly always used by the sculptor in preference to marble from any other locality. It is also largely used in decorating churches, such as altars, etc. We have already illustrated in the SCIENTIFIC AMERICAN SUPPLEMENT for February 12, 1898, the interesting quarries at Serravezza which Michelangelo exploited by the order of Leo X. The methods of sawing and working the stone at Carrara are very much the same as those described in that article.



LOADING THE MARBLE; QUARRIES OF CARRARA.

### School of Public Health.

The council of New York University has set apart buildings near First Avenue, between 25th and 26th Streets, for the use of a school of public health. There is a bill in the Legislature to provide for the maintenance of the school for the year which will begin October 1, 1899, by appropriating the sum of $25,000. The object of the new school is the promotion of public sanitation in all its branches and specially in the prevention and cure of diseases, by scientific investigations and the giving of free instruction in all methods and appliances for the prevention of disease. Free instruction is to be given to properly accredited sanitary officers, both lay and medical, of all the districts, towns, and cities throughout the State in matters pertaining to their official work. The school also calculates to give experimental training in sanitation to engineers of all kinds, civil, mechanical, mining, etc., to public school teachers, to sanitary inspectors of schools and factories, to inspectors of foods, sanitary inspectors of charitable institutions, and to all others who hold official positions which involve any responsibility for public health. It is to be also promoted by laboratory researches and scientific investigations. The public is to be instructed in all sanitary matters by university extension work. It is also calculated to render expert chemical and bacteriological assistance to the Board of Health and to public health officers. A hygienic museum will also be established.

### Death of Sir Douglas Galton.

Sir Douglas Galton died recently in London, at the age of seventy-seven. He was chiefly known in connection with his work in railway engineering and sanitary science, in both of which fields he was a great authority. He also rendered important service in the cause of submarine telegraphy. In 1858, when the Atlantic cable had broken down and the Red Sea and Indian telegraphs had proved a failure, the British government appointed a committee to investigate the subject of submarine telegraphs, and Sir Douglas was appointed chairman of the committee. In 1861 he published a report which is a most valuable collection of facts concerning submarine cables. He acted as General Secretary of the British Association for twenty-five years, and he has also been President of it.

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### Archæological News and Notes.

Some beautiful frescoes have recently been discovered in the church of the Frari, in Venice. They had been covered with whitewash in the seventeenth century.

Chæroneia's famous lion is to be restored and set up on the battlefield by the Archæological Society of Greece.

Money is being collected in England to help restore the belfry tower of the cathedral of Ravello, on the hilltop above Amalfi. It is necessary to strengthen and preserve the tower, as it is in a dangerous condition.

"Themis'ocles Phrearios" is scratched on an antique potsherd just dug up in the Areopagus at Athens. This is believed to have been one of the votes cast some twenty-four hundred years ago to ostracize the victor of Salamis.

The men-of-war of the ancient Romans had a crew of about two hundred and twenty-five men, of which one hundred and seventy-four were oarsmen working on three decks. The speed of these vessels was about six knots an hour in fair weather.

A massive silver goblet weighing over two pounds has recently been found at Windisch, the old Vendonissa, in the Canton Aargau of Switzerland. The goblet had been hidden with great care, probably by some Roman soldier. The work shows a warrior in armor with a Mercury and an ox.

It was rumored some time ago that France proposes to sell at auction the picturesque ruins of the walls of Aigues Mortes, the now silted-up port from which St. Louis, King of France, set out on his last crusade. It is said that the government also intends to sell a part of Mont Saint Michel to a company that wishes to build a casino.

An interesting discovery has recently been made in the Palace of the Senators at Rome, usually known as the Capitol. For several days workmen had been employed to remove a wall which showed signs of weakness, and in the course of the demolition a number of mediæval frescoes were discovered, the colors being extremely well preserved.

Naples' Castel Nuovo, the stronghold of the Angevine kings, lying between the royal palace and the harbor, is at last to become visible by the removal of the inclosing walls and shops built up against them. Under the Bourbons the castle was used for a dungeon for political prisoners and many of them were shot in the castle ditch without the formality of a trial.

The first ruins brought to light in the island of Milo are those of an ancient acropolis; there were also discovered the structure of three towns, each built over the other, and two of them, as indicated by the style of the fragments and vases, belong to the Mycenean era. The third lies next to the rock. The acropolis belongs to the island epoch before the introduction and development of Mycenean art. The excavations are regarded as very important.

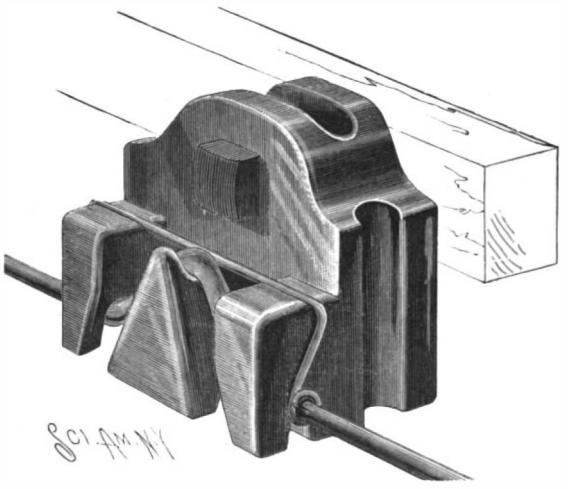
When the English captured the city of Benin, they found and sent to the British Museum some three hundred remarkable bronze castings. These present animals and human figures with various ornaments in relief. The lines are strong and the workmanship of great beauty. The origin of these castings greatly puzzles ethnologists. It is now thought by some archæologists, notably Mr. Read, of the British Museum, that they were the work of some European bronze founders who settled there in the sixteenth century.

A few months ago the Italian archæologist Signor Franceshini discovered in the church of Santa Croce, Florence, Italy, the tomb of Lorenzo Ghiberti, the designer of the famous Baptistry gates. He also found at a later time in the convent church of Sant Ambrose six famous graves containing the remains of the Florentine sculptor Mino, of Fiesole; Andrea del Verrocchio, the Florentine sculptor, goldsmith, and painter, who was the master of Leonardo da Vinci; Simone Pellaiuolo, Andrea Sansovino, the sculptor; Granacci and Leonardo Tasso.

In the cathedral of Genoa, Italy, is preserved, and has been for 600 years, a vase of immense value. It is said to be cut from a single emerald. It is 12½ inches in diameter and its height is 5¾ inches. It is kept under several locks, the keys of which are in different hands, and it is rarely exhibited in public, only by an order of the Senate. A decree passed in 1476 forbids anyone going too near the precious relic. A Genoese antiquary has written a book to demonstrate that this vase was one of the gifts made to Solomon by the Queen of Sheba. It would be interesting to know if this vase has ever been carefully examined by a gem expert of reputation. It seems almost impossible that a single crystal of emerald of anything like the size could be obtained, and that it could be cut. Unfortunately, many of the precious jewels preserved in Italy shrink wonderfully in value when examined by the expert. Thus many of the jewels on the Bambino, in the church of Aracœli, in Rome, are practically worthless.

### A NOVEL INSULATOR.

To provide a device which will serve both as an insulator and as a bracket for sustaining a wire, and which is adapted both to exterior and interior wiring, is the purpose of the invention illustrated in our engraving. The insulator, it will be observed, has a body portion eccentrically pivoted so that it can swing. The lower and heavier portion of the body is provided with three studs separated by grooves. Of these three studs, the central one is triangular in shape and is undercut to form an overhanging end. The two remaining studs are also provided with overhanging ends. In placing a heavy wire on the insulator, the body-portion may be rocked, and the wire laid in one of the grooves. By rocking the body-portion to the opposite



BLOES' AND HARLOE'S INSULATOR.

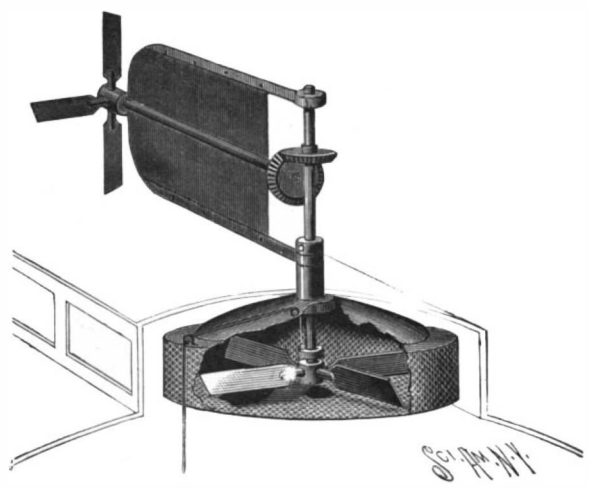
side, the wire may be laid in the other groove and on the triangular central stud. In this manner the heaviest wire may be bent upon the insulator with ease. If it be so desired, the wire may be further secured in place by a fastening, as shown in the illustration; but the use of such a fastening is not always necessary. By mounting the body portion so that it can rock, the insulator is enabled to yield to the sag of the wire and is not readily jarred or broken. The insulator has been patented by the inventors, Wilton S. Bloes and Morton Harloe, of Peckville, Penn.

### A SIMPLE VENTILATOR FOR RAILWAY-CARS.

The invention which forms the subject of the accompanying engraving is a ventilator which is designed to produce a thorough circulation of air in a railway car or other vehicle, without admitting dust or cinders. The invention has been patented by Lawrence White, of Dallas, Tex.

The ventilator comprises essentially two shafts, which carry the ventilating devices and which are connected by driving-mechanism.

Of these two shafts, one is vertically journaled in a bearing in the top of the car, and at its lower end is provided with a fan surrounded by a wire cage. Secured to an idler on the shaft above the fan is a cord, by means of which the shaft can be raised if desired.



WHITE'S VENTILATOR FOR RAILWAY-CARS.

At its upper end the shaft loosely receives the two arms of a vane.

In a bearing in this vane, the other shaft is horizontally journaled. This horizontal shaft is provided at its inner end with a bevel-gear meshing with a bevel-gear on the vertical shaft, and is provided at its outer end with a windwheel.

In the operation of the ventilator, the vane will automatically shift according to the direction in which the train is traveling, so that the current of air induced will revolve the windwheel. This motion will be communicated to the vertical shaft by means of the bevel-gears in order to drive the fan within the car. When it is desired to stop the fan, the cord secured to the idler is pulled, thus raising the vertical shaft and throwing the bevel-gears out of mesh.

### Science Notes.

During the recent religious fêtes in Turkey the government sent police officers to all of the druggists' shops to seal up packages of potassium chlorate in order to prevent its use in the manufacture of explosives.

M. Georges Claude has recently made experiments on the explosive power of acetylene at low temperatures. He finds that the solubility of acetylene in acetone increases very rapidly as the temperature diminishes, acetone at —80° C. dissolving more than 2,000 volumes of gas. Platinum wire may be kept at a red heat in this solution without any explosion taking place. Liquid acetylene at —80° C. behaves admirably.

Norway has passed a law prohibiting the sale of tobacco to any boy under sixteen years of age without a signed order from an adult relative or an employer. Foreign travelers are also forbidden to offer cigarettes to boys, and make themselves liable to prosecution if they do so. The police are required to confiscate all the pipes, cigars, and cigarettes of boys who smoke in the public streets. A sliding scale of fines is provided. They vary from 50 cents to $25.

Word has reached Shanghai from Yachow, in the interior of China, of the safe arrival there of the French explorer and adventurer M. Benin, after many narrow escapes from death on the trip through Thibet. After Mr. Landor's remarkable adventures in Thibet, we do not understand why any other traveler would wish to run the chances of going through the same ordeal. The people of this strange land are certainly within their rights if they do not desire the visits of foreigners, and resent their trespass.

Bonn on the Rhine has been investigating the liquor drinking habits of its small children. Out of two hundred and forty-seven children of the age of seven and eight years in the primary schools, there was not one who had not tasted beer or wine and about one-quarter of them had tasted brandy. Beer or wine was drunk regularly every day by one-quarter of them. Eight per cent received a daily glass of cognac from their parents to make them strong, and sixteen per cent would not drink milk because they said "it had no taste."

The Judge Advocate-General of the Navy has rendered an opinion which has been indorsed by the department, relative to the question of the staff officers of the navy having a title of rear-admiral while serving as chiefs of the Navy Bureau. He has decided that officers of the line, serving as chiefs of bureaus, must be addressed by their actual titles in the line, notwithstanding the fact that they have the rank of rear-admiral while holding an office as head of the bureau. Should a rear-admiral receive such an appointment, he would, of course, receive the full title of his position.

We have often spoken of the danger of contamination of wells by sewage, and a striking confirmation of it was offered when the water works machinery of a Maryland town of three hundred inhabitants broke down. For one day, water from an old well was used. Ten days later there was an outbreak of inflammatory intestinal disorders, and three cases of typhoid fever resulted. The water was tested and found to contain not less than 4,100 bacilli in one cubic centimeter, which is, of course, equivalent to about fifteen drops. The regular water supply contained 80 bacilli to a centimeter, which cannot be considered very satisfactory.

Recently a street car on Lenox Avenue, New York city, was set on fire by electricity and burned, and a car of the Sixth Avenue underground electric line was also burned a few days later. This seems to threaten a new danger to citizens who depend upon street cars operated by electricity as their usual means of conveyance. Fortunately no one was injured in either case, but had the cars been very crowded, it is very possible that serious physical injuries might have been inflicted. Such fires have occurred on electric cars ever since the beginning of electric railroading. Fortunately, they start outside the car, so that chances are given to the passengers to make their escape. It would not be at all a bad idea for all electric cars to carry a small fire extinguisher. This is done on many steam railroads and on the Brooklyn Bridge.

According to the correspondent of The Daily Chronicle, the irrepressible Szczepanik, the young inventor, has presented the Emperor Francis Josef with the first web produced by means of his photographic process. It is about two meters square and gives an allegorical representation of homage to the Emperor. It is said the work contains 200,000,000 crossings, 120 silk threads filling one centimeter. Two hundred square meters of pasteboard cards would have been necessary to produce this web according to the methods now in vogue, and designers would have required many years to carry out the work. It is said the work was done in five hours. Unfortunately, all of Herr Szczepanik's inventions are shrouded in mystery. However, at the coming World's Fair he promises to unbosom himself, and we shall probably have to wait until that time for explicit details of his inventions.

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### FRENCH SUBMARINE TORPEDO BOATS.

(Continued from first page.)

to rise quickly to the surface in case of emergency. As the boat was built merely for experimental purposes, it did not carry any torpedo or torpedo tubes. The illustrations which accompany this article show the "Gymnote" at the surface of the water, just after making one of her trial plunges, and the other shows her traveling at the surface with the crew standing upon the bridge or navigating platform which extends amidships on the upper part of the hull. This platform was added subsequently to the first construction of the vessel and does not appear in the sectional view. The tall tube which stands vertically just in front of the pilot house is the "Prismoscope," which is designed to be used when the vessel is submerged, for the purpose of keeping the enemy in sight and determining the bearings of the vessel itself. The upper part of the tube is capable of being bent at right angles and directed to any part of the horizon, so as to give the navigator below an all-round view.

The trials of this little craft were so satisfactory that Zédé determined in 1890 to build a boat of the same type, but of much larger dimensions. The vessel, which was at first known as the "Siréne," was in later years known as the "Gustave Zédé." After construction had been commenced, a few modifications were made in the original plan, such as the substitution of bronze for steel in the construction of the hull and the addition of a platform for use at the surface of the water. Particulars of the vessel are as follows: Length, 147 feet; diameter, 10·75 feet; displacement, 260 tons. The hull is of the general cigar shape, with long and sharply pointed ends, and its model conforms more nearly to the earlier patterns of the Whitehead torpedo than to the later pattern, which has a short, blunt head. The maximum speed on the surface is 14 knots, and about 8½ knots when submerged.

The vessel carries a torpedo discharge tube, which is located in the nose and lies in the longitudinal axis of the boat, and a supply of Whitehead torpedoes containing a charge of 220 pounds of guncotton. It carries a complement of ten men.

The "Zédé" has been the subject of long and tedious experiments, and for two years, during which the ship lay idle, nothing whatever was done upon her. During the last year, however, the experiments have been carried on with very promising results, and her successful experimental attacks upon the French battleship "Magenta," which were made both while the latter was at anchor and in motion, have won for this vessel a world-wide reputation. These experiments were carried out in the vicinity of the Hyeres Islands, and the series was terminated by a trip of about 40 miles from Toulon to Marseilles, during which the "Zédé" behaved exceedingly well, in spite of a somewhat rough sea. After reaching Marseilles the accumulators were still sufficiently charged to enable the boat to make the return trip to Toulon, thereby proving that their capacity is equal to a continuous run of from 75 to 80 miles. It is thus seen that the boat, if used in defense of a blockaded harbor, would have a radius of action extending 35 miles in any direction.

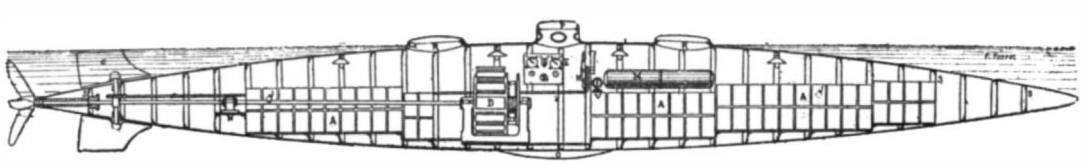
It has been decided to construct another vessel, to be known as the "Narval," which shall be an improved "Zédé," with a greatly enlarged radius of action. The "Narval" was put upon the stocks last year and will be pushed energetically to completion.

It is needless to say that these successful experiments with the "Zédé" have provoked widespread comment, both favorable and adverse. In the first rush of enthusiasm the average Frenchman sees himself in the possession of a weapon which neutralizes at a stroke the invincible powers of the battleship; but as a rule the professional men of the army, and particularly of the navy, have estimated the new vessel at its true worth. Vice-Admiral Dupont, an old and experienced naval officer, has recently warned his countrymen in the columns of the Gaulois against jumping to hasty conclusions regarding the possibilities of the submarine class of war vessels. He says:

"The recent trials of the 'Gustave Zédé,' the presence of the Minister of Marine at these trials, and especially the note, in a certain sense official, which gave forth to the world the success obtained, seem to me to have somewhat excited public opinion, which, always ready to overshoot the mark, will conclude, if care is not taken, by attributing to the submarine boat qualities which it cannot possess and a condition of perfection which has not yet been reached. From this point to attributing to them a part which they can never play in warfare, and forcing our naval constructions on a wrong road, is but a single step. It is necessary that, on the question of submarine vessels, the public should clearly understand that, in a naval war, they have no other than the extremely limited mission of rendering difficult and sometimes dangerous the blockade of a friendly port. It is certainly something, but that is certainly all. It is a question of a weapon offensive in its employ, but purely defensive in its action, especially and almost exclusively necessary for those navies which cannot acquire the supremacy of the seas. The British have never been mistaken. Owing to the undoubted power of their fleet making it improbable, almost impossible, for one of their ports to be blockaded, they have concerned themselves very little with torpedo-boats, preferring to build destroyers with which to annihilate these vessels, and they only seem to have slightly concerned themselves with the submarine navigation question."

The admiral deprecates such hasty action as would be involved in the immediate construction of a fleet of submarine ships, and urges that the French government should conduct further and more exhaustive experiments with the "Zédé" in order to determine her exact powers of attack and defense.

Our accompanying illustrations show the external appearance of the submarine boat when she is traveling at the surface. The photograph from which the engraving was made was taken on the homeward trip when the "Zédé" was returning from its experiments in diving. The crew is grouped about the conning tower on the narrow deck or platform; the officer and two of the men are standing upon a kind of poop which is reached by means of a ladder. The hatches are on a level with the platform, which latter, as we have said, was added subsequently to the completion of the vessel for the purpose of facilitating the boarding and debarkation of the crew. The longitudinal section shows in detail the interior arrangements of the vessel. *L* is the torpedo discharge tube, shown with a torpedo lying within it ready for firing. To the rear of the tube is a rack, *J*, carrying a torpedo, *X*. *A*, *A*, *A*, represent the storage batteries, and *D* the motor; *P* is the conning tower, and below and forward of it is the steering wheel, *H*; *G*, *G*, are the vertical rudders for steering the vessel in a horizontal plane, and horizontal rudders which control the diving and submersion are arranged on each side of the boat.



SECTION THROUGH THE SUBMARINE BOAT "GYMNOTE."

### Discovery of a Mammoth.

On February 8, a Swede and his partner, while marking their claim on Dominion Creek, discovered, according to a Dawson newspaper, a body of a mammoth 40 feet below the surface. The story was that the body was in a perfect state of preservation. Unfortunately, there were no scientists in Dawson to examine the body, but, according to press statements, it measured 44½ feet long. Its right tusk was broken, but its left tusk was perfect, so that it was probable that the right tusk may have been snapped off in the fall that caused its death. The tusk which remains measures 14 feet 3 inches in length and 48 inches in circumference. The flesh was covered with woolly hair 15 inches long, of a grayish-black color. The neck was short and the limbs long and stout, the feet short and broad, and had five toes. The flesh was cut and tasted sweet. Mammoth flesh has been tasted on other occasions. It is very unfortunate that an expert geologist was not upon the ground at the time of the find, as it is of considerable importance.

### Acetylene Gas Congress.

An international exhibition of acetylene gas methods and appliances will be held in May at Budapest, Hungary, in connection with the second International Acetylene Congress. The industrial palace will be utilized for the exhibition, and silver and gold medals will be awarded. The deliberations of the congress will bear upon the theoretical and practical questions relating to carbide and the acetylene gas industry. It will discuss the standard methods for the control of carbide and acetylene gas and the best means for removing the obstacles which prevent the general use of acetylene gas. Anyone who is interested in the industry may become a member of the congress upon the payment of five florins, and he will then receive the publications of the congress. The secretary is Bela Szasz, Budapest, Hungary.

### A Scheme to Fortify Hart's Island.

There is reason to believe that the United States government intends taking Hart's Island in Long Island Sound for the purpose of fortification, and that a number of disappearing guns of large caliber will be mounted on the highest point of the island, which commands the Sound. The government has already made surveys. There are a number of buildings on Hart's Island, which were formerly used by the city and State for charitable purposes. The plateau on Hart's Island is 500 feet long and 250 feet wide and stands exactly at the entrance to Long Island Sound.

## Correspondence.

### A Correction.

To the Editor of the SCIENTIFIC AMERICAN:

On page 178 of the SCIENTIFIC AMERICAN for March 25, I regret to see an announcement that Prof. Thomas J. See "has been designated as Chief of the Nautical Almanac, to succeed Prof. Newcomb." This statement is without a shadow of foundation in fact, and I trust you will correct it, in order to avoid misleading the very large number of persons interested in science who rely implicitly upon your valuable paper. Prof. See has been assigned to a subordinate position in the Naval Observatory, and has nothing whatever to do with the Nautical Almanac Office.

WILLIAM HARKNESS.
Professor of Mathematics, U. S. N.
March 27, 1899. Director, Nautical Almanac.

### The 1898 Stamp Issue.

To the Editor of the SCIENTIFIC AMERICAN:

During the year 1898 the United States Bureau of Engraving and Printing issued 2,500 000,000 of the common red two cent stamps—enough to go almost twice around the earth. Stacked one upon another, they would pile up 150 miles beyond our atmosphere, equal in weight to two of our big locomotives, and would make a blanket to keep the frost off the city of Washington. If these stamps worked in relays, each taking the letter as far as allowed by the postal regulations, the letter would be carried beyond the most remote star; and, at the fastest speed at the disposal of the postal authorities, would occupy millions of times the age of the earth in transit.

Washington, D. C. C. FRANCIS JENKINS.

### The Strangest Insect in the World.

To the Editor of the SCIENTIFIC AMERICAN:

With reference to Mr. Fitton's letter, page 103 of the SCIENTIFIC AMERICAN of February 18, 1899, the "night butterfly" mentioned by him evidently refers to the large moths Hepialus virescens and rubriviridans, from 4½ to 5¼ inches in expanse of wing, virescens being the smaller of the two; the former is a beautiful green insect with satiny white upper wings marked with irregular darker green lines, and with whitish green under wings, the latter having green upper wings with dark reddish brown markings, and under wings of a pale rust color. Both are tree borers, not root feeders, as stated by some writers, so far as my experience goes. Virescens bores principally in the wood of the New Zealand currant, Aristotelia racemosa, or wineberry tree, as the settlers call it, and rubriviridans in that of the Manuka leptospermum and Rata melrosideros robusta. They are believed to be attacked by Robertsii, and are distinct species from the large brown moths of the genus Pielus, whose caterpillars are also attacked by the same fungus. With regard to the mode of attack, the root feeders might become impregnated by burrowing in the ground in search of food by the spores lodging in the folds of the skin of the neck or other parts of the body, as similarly suggested by Mr. Gray in his "Notices of Insects," pages 6, 7, or the larvæ might swallow the seed with their food; but whether the spores would survive the destroying influence of the gastric juices of the caterpillar's stomach, I could not say, unless the animals were in such an enfeebled condition by the excessive moisture of the ground as to be unable to resist the germination of the fungus, in which case both Mr. Taylor and Mr. Colenso are of opinion that it would gain the upper hand. The soil would no doubt be well supplied with spores washed into the burrows by the heavy spring rains, and as the fibrous roots spread far and wide and many lie near the surface, it may not after all be so difficult to conceive how the fungus gains a permanent hold of the bodies of the caterpillars.

Mr. Fitton states that he has observed the fungus in many stages of growth, undeveloped imagos, and remnants of moths scattered in the vicinity, the latter probably the work of the New Zealand morepork owl, Athene Novae Zealandiae, or, as the Maoris term it, Kainanga. A collection of such objects is very desirable, as it would, no doubt, tend to verify much that has been said on the subject or correct erroneous impressions. These remarks by no means settle the question, but I think it may be safely conceded that the mystery in which the vegetable caterpillar has been so long shrouded is now in a great measure solved.

GEORGE J. GRAPES.

5 Terrace Road, St John's, Newport, Isle of Wight, England.

### More Workmen for the Panama Canal.

The officials of the Panama Canal Company have decided to send agents on March 24 to Jamaica for the purpose of securing 500 to 1,000 additional laborers to work on the canal.

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## CAUSE OF THE RECENT EXPLOSION OF THE TEN-INCH GUN AT SANDY HOOK EXPLAINED.

BY HUDSON MAXIM.

At the Sandy Hook proving grounds, on Wednesday, March 29, a ten-inch gun burst, killing one man and wounding several others, the gun being literally blown to fragments.

According to newspaper accounts of the disaster, a full charge of 141 pounds of smokeless powder had already been fired, registering a pressure of only 33,000 pounds to the square inch. A small addition to the charge was made for the next round, about enough, it was intended, to bring the pressure up to 35,000 pounds.

The pressure gage found after the explosion indicated a pressure up to its full capacity of 79,000 pounds to the square inch. How much the pressure was which burst the gun there is of course no means of knowing, but it is probable that it exceeded 100,000 pounds.

This is not the first time that smokeless powder has shown itself to be very erratic. The reason for such tremendous mounting of pressure on the addition of but a small quantity to a charge which had previously given only 33,000 pounds to the square inch is a problem which requires careful consideration. The writer believes he can explain the curious phenomenon and the cause of the erratic action. He also believes that the remedy here suggested, if and when adopted, will avert further disaster.

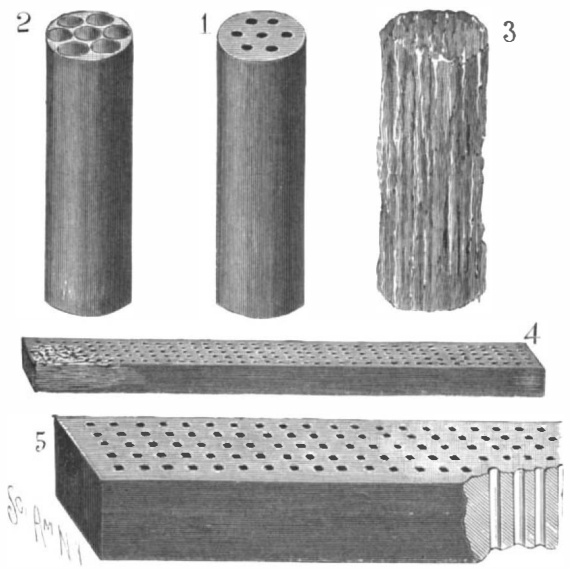
The writer understands that the smokeless powder grains which were used in the above test were in the form of cylinders about three diameters long, and longitudinally perforated with seven holes (see Fig. 1). In loading the gun these grains are filled into bags, which are placed in the powder chamber, the bags approximating in diameter the size of the powder chamber. On firing, the powder charge is ignited by a small flash charge of black rifle powder. When all goes well, the combustion of the grains progresses regularly from all the exposed areas, both outside and inside of the grains, as explained and illustrated on page 31 of the Army and Coast Defense number of the SCIENTIFIC AMERICAN SUPPLEMENT, July 9, 1898.

As smokeless powder burns with a rapidity increasing with the pressure, the combustion within the perforations is somewhat more rapid than upon the exterior surfaces of the grains, owing to the work required to displace the products of the combustion as formed. Fig. 1 shows the grain before being fired, having equal burning thicknesses between the perforations and between the outer circle of perforations and the circumferential surface of the grain. Fig. 2 shows the same grain partially consumed by firing in a gun too small and under too low a pressure to effect complete consumption. This grain was recovered in front of the gun after firing, having been ejected from the gun end on with great velocity, so that the rush of cold air through the perforations extinguished the flame. It will be observed that the remaining unconsumed walls between the perforations are much thinner than the outer and circumferential wall of the grain. This evidences considerably more rapid combustion within the perforations than upon the outer surfaces.

If we were to take a longitudinally perforated cylinder of smokeless powder, say eighteen inches in length, and ignite one end of it, and allow it to be burned in the open under atmospheric pressure, the flame would run along through the perforations and jets of flame would be thrown out at both ends with great violence, until the pressure mounted sufficiently high to explode the grain, blowing it into fragments at its central portion. If we take a similar rod or grain about 8 inches long and ignite it in a similar manner, we shall find that it will not explode as in the other instance. If, however, instead of burning this shorter grain in the open, we should place it in a gun and fire it under considerable pressure, it would burst, owing to the increased rapidity of interior combustion, with proportionate increase of internal pressure in excess of external pressure. Fig. 3 illustrates a grain which has been shattered by internal pressure.

As the external pressure upon the grains is increased, the internal pressure rises in due proportion, so that a length of grain and size of perforation which will not burst under atmospheric pressure will burst in a gun when the conditions of confinement become such that the internal pressure becomes so much in excess of external pressure as to exceed the bursting strength of the grain. Similarly, a length of grain and size of perforation which will stand without bursting when fired in a gun under a given pressure may not stand if the pressure be increased. In other words, the length and size of perforation must be in keeping with the degree of pressure to which the grain is to be subjected in the gun.

The grain used in the above disastrous test, while it would probably stand without disruption a pressure,




1, 2, perforated powder before and after partial combustion; 3, powder after being shattered; 4, 5, new powder with transverse perforations.

6.—SKETCH SHOWING POWDER JAMMED IN THE COMPRESSION SLOPE OR NECK OF POWDER CHAMBER.

say, of 50,000 pounds to the square inch, or even somewhat more, would yet be disrupted under a sufficiently high pressure, say of 75,000 pounds. Consequently, it is not likely that the bursting of the grain in the above test was due simply to the sudden mounting of the pressure occasioned by the slight addition to the charge. It is probable that another cause operated to mount the pressure abnormally high and beyond the bursting limit of the grains, and which, coacting with their disruption, raised the pressure to a tremendous height and destroyed the weapon.

Let us consider what probably took place. The flash charge set the whole charge forward against the projectile, and rammed it into the contracted neck of the powder chamber, where it narrows down to the rifled portion. The products of combustion set free at the rear of the charge, finding vent only by passing through the charge to follow the projectile along down the bore, produced a considerable excess of pressure at the rear of the charge, which tended to jam the forward portion still harder into the narrow neck (see illustration, Fig. 6). As a result of the excess of pressure at the rear of the charge and the impeded escape of the gases through the jam, the grains constituting the jam were more or less crushed, presenting a greatly increased burning area, with corresponding increase of pressure, which was sufficient to blow up all of the uncrushed grains, increasing still more, and to an enormous degree, the burning areas, and resulting in a pressure sufficient to burst the gun.

The substance of the powder grains under consideration is a very hard and vitreous colloid, and although it possesses considerable tensile strength, being by no means fragile, yet it is capable of being readily crushed or blown into fragments.

Explosive compounds are burned in two ways, one from surfaces, the other by what is called detonation, where the explosive is consumed nearly simultaneously throughout its mass by a wave action.

If a grain of smokeless powder be cut up into a fine sawdust and confined, and fired with a strong exploder, it will detonate like dynamite. Fibrous guncotton consists, in reality, of fine tubes, whose walls consist of a vitreous colloid, and the difference between guncotton in a fibrous state and that of the hard colloid used for smokeless powder is one of difference in the amount of surface presented—a difference in physical condition.

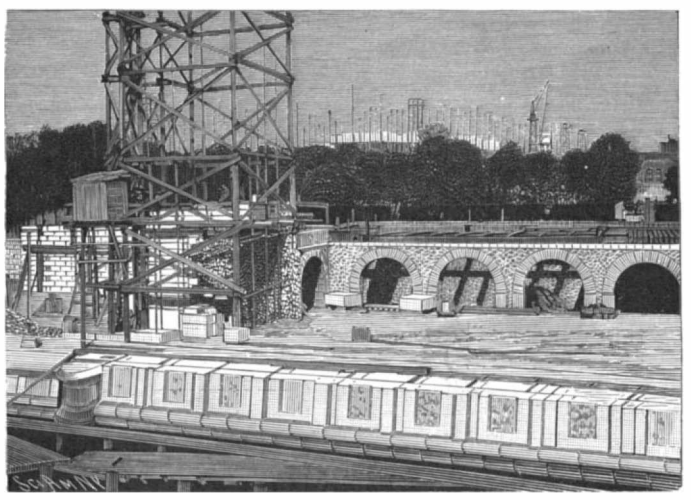
If a piece of smokeless powder be dissolved in acetone, and poured in a fine stream into water, the water will absorb the acetone and precipitate the smokeless powder compound in a fine state of division, with a fibrous texture resembling very closely the original guncotton. This substance will detonate with the same ease and violence as fibrous guncotton; and, if the smokeless powder contains a percentage of nitroglycerine, the artificial fiber thus produced will detonate with even greater violence than guncotton.

The foregoing considerations make it easy to understand how the disruption or crushing into fine fragments of powder grains in a gun can cause the pressure to mount to a degree approaching that which would be produced by detonation.

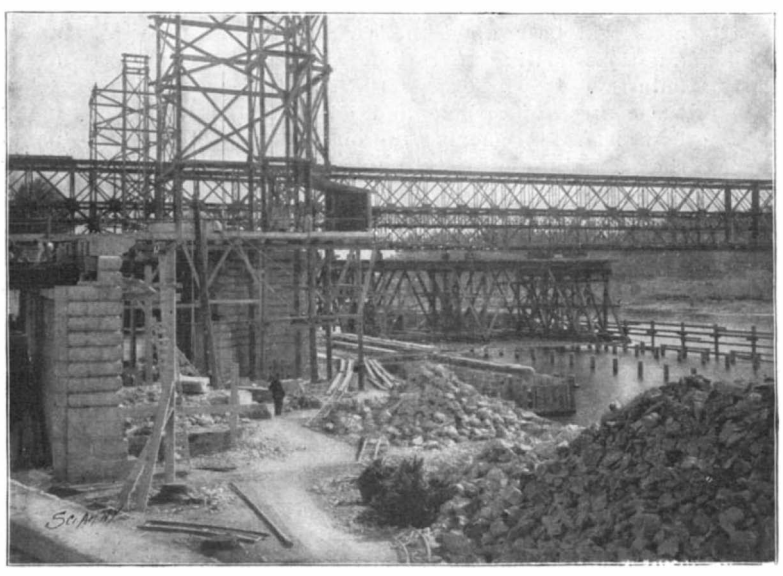
The writer believes that the higher and higher ballistics which are constantly being sought, and the higher and higher pressures that are being employed to attain the highest possible velocities, will require a modification in the present form of powder granulation now adopted by this government. Although the writer is himself one of the inventors of this grain, he does not believe that the longitudinally perforated grain is the ideal form for the attainment of the highest ballistics. If the grains be shortened so that higher pressures may be had without danger of disruption, we still have the same danger of jamming into the forward end of the powder chamber. Furthermore, as the grains are cut shorter, the amount of initial burning area is increased, with consequent lowering of the ballistic qualities of the powder.

The writer believes that the grain shown in Figs. 4 and 5, made in lengths of, say, eighteen inches, and having a thickness of from three-quarters of an inch to one inch, and a width of from one inch to one inch and one-half, and multiperforated in the manner shown, is a much preferable form. The burning thicknesses between the perforations should be adapted to the caliber of the gun in which the grains are to be employed. Such a grain packed into the powder chamber in a longitudinal direction to the bore would be incapable of jamming, while the initial area per unit of weight of material would be even less than that now presented to the flame of ignition by longitudinally perforated grains. The perforations could also be made smaller without danger of disruption from internal pressure, and a greater increase of burning area secured.

While finely granulated smokeless powder, or a smokeless powder sawdust above described, may be made to detonate like dynamite, yet it must be borne in mind that the pressure necessary to produce the detonative wave in such material is very high indeed, and much higher than ever could be attained in guns under normal service conditions. It is probable that the hard colloid of which



ABUTMENT OF THE ALEXANDER III. BRIDGE.



THE 1900 PARIS EXPOSITION—FOOT BRIDGE FOR USE IN CONSTRUCTION OF THE ALEXANDER III. BRIDGE.

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the grains were composed which blew up the 10-inch gun would not detonate under 100,000 pounds to the square inch, although the rapidity of combustion under that pressure would be very great. To detonate the compound, it must be subjected to a sudden pressure sufficient to force upon the constituent molecules a rearrangement. It is probable that the powder did not detonate in the 10-inch gun in the true sense of the word.

It is probable that had there been placed in the gun, with the charge which exploded it, a piece of powder material of the same size and character as the grains fired, but without any perforations, it would not have been all consumed.

## A GLIMPSE OF THE PARIS EXPOSITION OF 1900.

BY CHARLES RICHARDS DODGE.

The grounds of the Paris Exposition of 1900, lying within the city, comprise four plots or tracts, two of which, the Champ de Mars and the Esplanade des Invalides, are situated south of the Seine, with two lesser tracts, the Trocadero grounds and the site of the Art Palaces, situated on the north side of the Seine. The main tract, the Champ de Mars, and the Trocadero grounds just across the Seine, are connected by the Pont d'Iéna, and thus form one section. A second section is formed by uniting the Esplanade with the plot taken from the city park system, the two being united by the beautiful Alexander III. bridge, in process of construction. These two sections are connected along the Seine by considerable spaces on either side of the river, formed by the Seine embankments, and, on the south side, by taking in Quai d'Orsay, one of the city streets. While the several sections are almost in the heart of Paris, with blocks of buildings and systems of streets between, it will be possible to fence the grounds into one inclosure, with gates at different points, so that one ticket will admit to all parts of the grounds. It should be mentioned that another section of the Exposition will be located in Parc Vincennes, eight miles distant, though directly connected with the Exposition grounds by rail, with rapid trains running at short intervals.

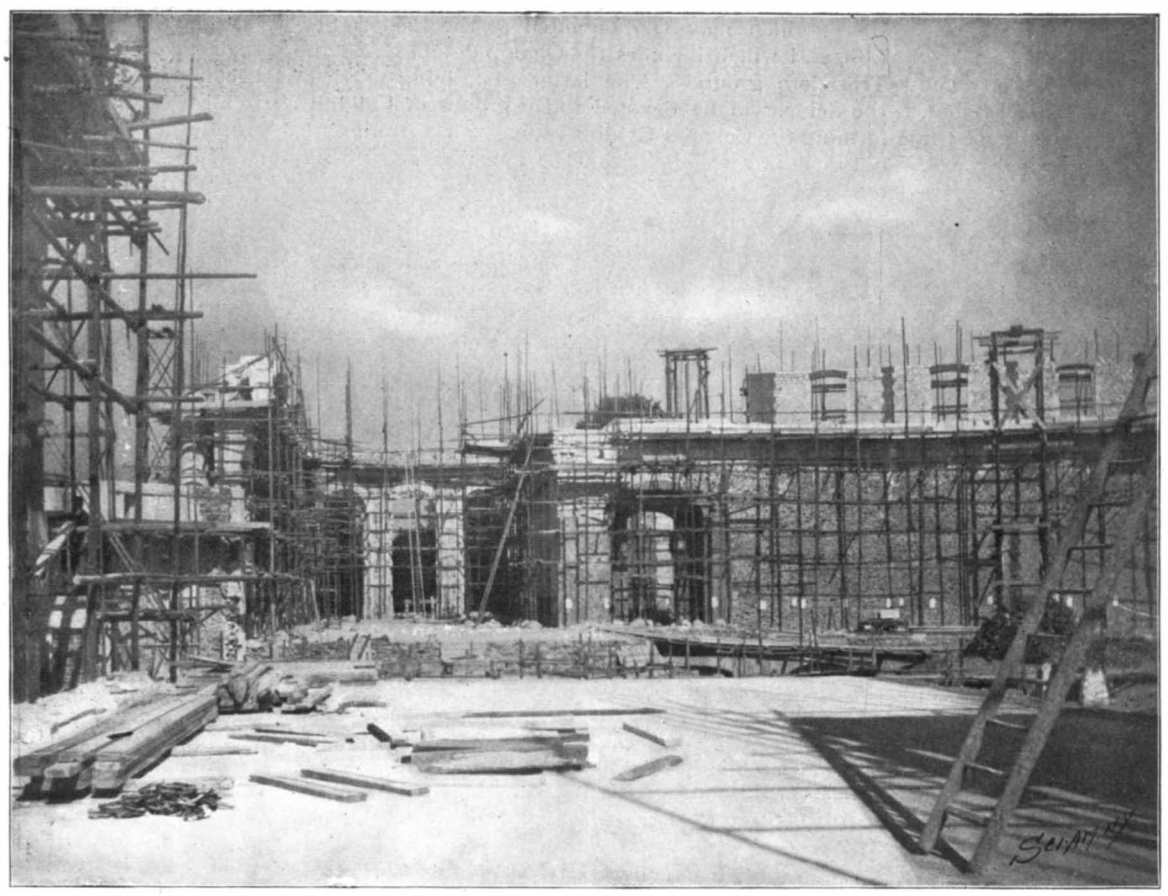
The main entrance to the Exposition proper will be near the Place de la Concorde, and, therefore, only a short distance from the garden of the Tuileries. The eastern sections of the grounds nearest to this point are to be connected by a magnificent piece of permanent engineering work over the Seine, to be known as the Alexander III. bridge. Upon the large tract extending along the north bank of the river, which was acquired by using a portion of the park system between Cours de Reine and the Avenue des Champs Elysées, and including the site of the now demolished Palais l'Industrie, two superb palaces of art are in process of construction, which are to be permanent. To make room for these immense structures it was necessary to sacrifice the old Palais l'Industrie, and, to make the buildings themselves more imposing, a new thoroughfare is to be established, the Avenue Nicholas II. Starting from the Avenue des Champs Elysées, this thoroughfare will pass between the two Art Palaces, upon which they will front vis-a-vis, and, crossing the Seine by means of the new Alexander III. bridge, will extend the entire length of the Esplanade des Invalides in a straight line, ending at the Exposition building that forms the boundary of the grounds in this direction.

In the effort to secure all available space, even the Seine has been encroached upon, and the embankments extended further out into the stream on either side at large outlay, the surface of the new embankments being at a lower level than those at present existing.

When in Paris recently it was my good fortune to be permitted to go through the ateliers of the Exposition, for the present located in that portion of the old Palais l'Industrie still standing, where are to be seen the plaster models, in exquisite detail, of two palaces of art, models of portions of the bridge structure and its approaches, besides many beautiful models and designs of art work to be used upon the bridge and to enrich façades of Exposition buildings now in process of construction.

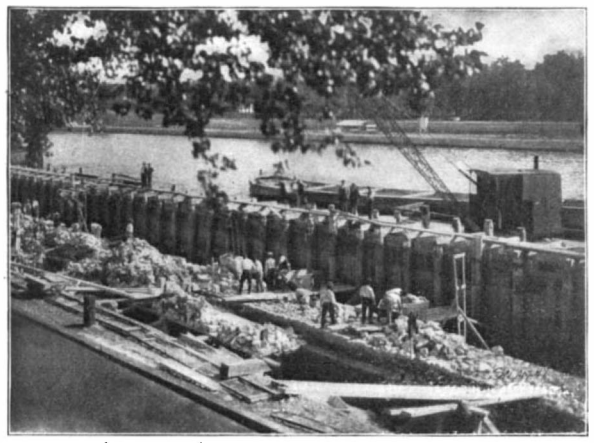
The Grand Palace of Fine Arts, which will house the treasures of sculpture and painting of all nations at the Exposition, is on the west side of the Avenue Nicholas II. and quite near the famous Avenue des Champs Elysées. Prizes to the value of 45,000 francs were offered for designs for this building. The design of M. Louvet was selected from sixty competitors, and the first prize of 15,000 francs was awarded to this architect. The accompanying illustration shows the fine massive proportions of the Grand Palace, which is constructed of cut stone, the same that is used so largely for building purposes in the city of Paris. The palace is provided with two grand staircases, and will have an imposing entrance hall. The first floor will be devoted to a series of superb exhibition rooms for paintings, and an enormous salon is provided for sculpture. There will also be suites of smaller exhibition rooms, besides a café and other rooms for entertainment or comfort of the Exposition visitors. Ample arrangements have been made for lighting all of these exhibition rooms, the upper ones, of course, being lighted from the roof.

The lesser Palace of Art, an interior view of which is shown, known as the Girault Palace, from the name of the architect whose design was accepted, occupies a position on the east side of the Avenue Nicholas II. It will be a permanent structure, similar to the Grand Palace in materials and general style, and I understand will be devoted to historical treasures, a part of the

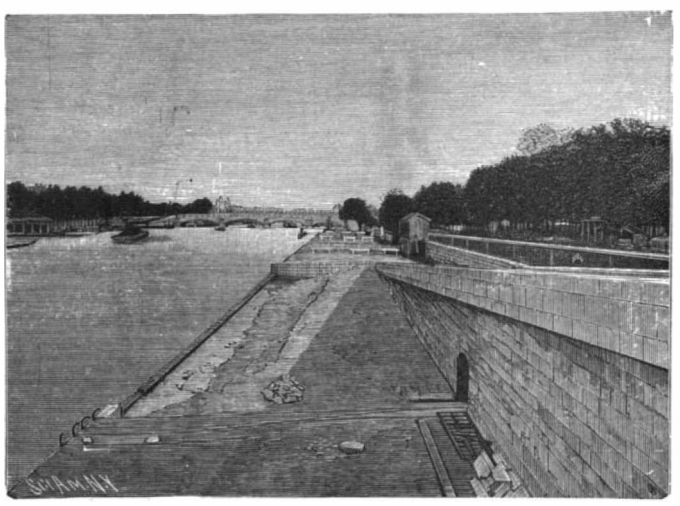


THE 1900 PARIS EXPOSITION—INTERIOR OF THE SMALLER ART PALACE.

THE 1900 PARIS EXPOSITION—EXTERIOR OF THE GRAND ART PALACE.



THE SEINE EMBANKMENT COFFER DAM.



ENLARGED AND COMPLETED SEINE EMBANKMENT.

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grand retrospective exhibit which is the raison d'etre of the Exhibition of 1900; that is, to show to the world the progress of the past hundred years.

It is the intention of the Exposition authorities to beautify the grounds surrounding the Palaces of Art in such manner that the landscape will connect naturally with existing shrubbery and trees, giving a park-like aspect, which will harmonize with the famous promenade, the Avenue des Champs Elysées, immediately to the north.

Passing from this grand promenade and drive, through the new Avenue Nicholas II., to a point south of the Art Palaces, the visitor comes to the Seine, and to the extensive works now in progress on the new Alexander III. bridge, which will doubtless be one of the architectural features of the Exposition. The corner stone of this structure was laid in October, 1896, by the Czar of Russia. The architects of the bridge are Messieurs Cousin and Cassien-Bernard, while the construction is under the immediate supervision of Messieurs Resal and Alby. It is to be a single span bridge, 110 meters in length over all, with a width of 40 meters. While the main arch, naturally, will be of steel, the foundations will be of granite, though other stone will be used in the structure, even marble, in connection with bronze, with which some very beautiful ornamental effects will be produced. The general style is Louis Quatorze, with many statues and decorations; some of the models for which it was my pleasure to see in the workshops of the Exposition. Among the artists represented are Fremiet, Dalou, Gardet, Cordonnier, and others. During the construction period an iron foot bridge will span the Seine, just beneath which the work will go on. This foot bridge was built in sections and "thrown" or "launched" into position from the north side of the river. One of our illustrations shows its appearance when it had only extended as far as mid-stream. The other small illustration gives an idea of the solidity of the arch springing from the abutment. Beyond are arches to support the esplanade above, and in the distance are the walls of the great Art Palace. One peculiarity of the Alexander III. bridge is that the span is to have a rise of only one foot from ends to center.

The series of palaces on the Esplanade des Invalides will be devoted largely to exhibits in manufactures and the various industries. The United States has secured ground space in this portion of the Exposition, near the Alexander III. bridge, upon which to erect a building which will give about 15,000 square feet of space for various groups of exhibits.

On the Seine embankment, west of the Alexander III. bridge, will be placed some of the most interesting and beautiful structures of the Exposition. On the south embankment, between Pont des Invalides and Pont de l'Alma, will be constructed the Palaces of Nations, in the midst of which our own beautiful national building will have a prominent position. While the plans of this building show a structure worthy of this great nation, it is believed that one or two buildings, to be erected by other nations, will cost more money, as they will be veritable palaces. The United States building, which will house a few exhibits of national interest, will be the headquarters and home of all good Americans at the Exposition. A little further along, likewise on the south side of the river, between Pont de l'Alma and Pont d'Iéna, will be placed the Exposition building, to be devoted to army and navy exhibits, and beyond this the Palace for Commerce and Navigation. The United States will erect an annex near to this building on Quai d'Orsay, in which will be housed exhibits relating to our merchant marine and the United States Weather Bureau. The building has been specially planned with regard to the uses of the United States Weather Bureau, and a novelty in this exhibit will be a working Weather Bureau observatory on the roof, accessible to the general public by an easy flight of stairs leading to a tower, with exit, on the roof level. The instruments on the roof are to be connected with those displayed in the exhibit hall below, in order that the public may be able to study every phase of weather observation and forecasting, including preparations for publication and the printing of daily reports.

Another prominent building, just beyond the Merchant Marine, is the Forestry and Fisheries building, almost under the shadow of the Eiffel Tower. On the north bank of the Seine, opposite to the palaces of the foreign powers, will be located the Palace of Horticulture and the Palaces of Social Economy and the city of Paris. The United States will have a very desirable location in the Horticultural building, and extensive arrangements are being made for the exhibits in this special department.

The work upon the new Seine embankments, upon which the buildings bordering the Seine will be constructed, has been in progress for many months. The manner in which the Seine is being encroached upon in order to give available space for these new buildings is shown in two of the small illustrations from photographs taken in the autumn of 1898 by the writer. Just beyond the proposed limits of the new embankment in the river double lines of piles are driven a few feet apart and parallel with the shore. The space between is then filled in and a bulkhead is thus formed. Other bulkheads are raised at intervals, running from the main line of piles to the shore, and, after pumping out the water which fills a particular section, the masonry work is begun. The other small illustration shows the appearance of the completed embankment, the incline on the right being the line of the river prior to the improvement. Additional temporary foot bridges are to be built over the Seine to provide ample facilities for crossing the river from one part of the exhibition grounds to the other.

We have now reached the main portion of the Exposition, which may be designated as the Eastern Section, and which includes the Champ de Mars and the Trocadero grounds. The latter plot, lying north of the Seine, will be devoted to the groups of buildings forming the Colonies Exhibits, some thirty in number, not including the Palace of the Trocadero, which was erected for the Exposition of 1878.

By far the larger portion of the Champ de Mars is covered by a series of palaces, practically under one immense roof system, which will house the following groups of exhibits: Agriculture and food products, machinery and electricity, textiles and clothing, mines and metallurgy, chemical industries, civil engineering, education, science and arts, etc. Just north of this series of connected palaces stands the Eiffel Tower, to the left of which is the palace devoted to the monster telescope, illustrated in a recent number of the Scientific American. Mention should also be made of the Annex to Agriculture, which is to be erected by the American Commission, and which fully doubles the space originally allotted to the agricultural groups.

The old Palace of Machines which was used in 1889 is to be devoted to agriculture and food products, and will be known as the Palace of Agriculture. Nearly one-third of the central portion of the floor space of this structure, on Champ de Mars, is to be given up to the magnificent festival hall of the Exposition.

As previously remarked, the principal entrance, which is located very near the Place de la Concorde, and close to the Seine, will be in the form of a triumphal arch, upon the face of which will be emblazoned the arms of the city of Paris, while it will be surmounted by a colossal statue of Liberty. It is claimed that it will be possible to admit 60,000 persons per hour without difficulty.

Mr. F. E. Drake, Director of Machinery and Electricity for this country, states that the part which machinery and electricity will play in the coming Exposition is a more important one than ever assumed by these two great industries in former expositions. In a general way it may be said that but few important changes or improvements will be shown in the service of the Paris Exposition over the Columbian Exposition of 1893.

The great service power plant of the Exposition will occupy a favorable position in the main group of buildings. It will be installed immediately adjoining the space allotted for the exhibits of electrical and other machinery, and any benefits which might naturally accrue to the builder of machinery installed in the service plant will be accentuated by reason of its being located in close proximity to the exhibits not offered for regular service. The capacity of the boiler plants for the service of the Exposition will be approximately 20,000 horse power.

It is the Palace of Electricity to which all eyes will naturally turn at night, and as its main façade reaches across the entire width of the open plaza in the center of the Champ de Mars, splendid opportunity will be afforded for the attractive treatment of the architectural features of the exterior of this palace.

While the city of Paris will doubtless supply the "Midway" attractions, ad lib., there will be many novelties at the Exposition of 1900. Just across Avenue de Suffren from the Palace of Agriculture, there will be a mammoth wheel, some 25 feet higher than the famous Ferris wheel of Chicago, but built on a somewhat different principle. To the writer it appeared like a pair of mammoth suspension bicycle wheels, with swinging cars hung at intervals around the rims. It will be illuminated at night by electricity.

The Luminous Palace will be another novel feature, as it is said that it will be the greatest piece of glass and stained glass work ever produced. It will be over 100 feet in height. Its staircases are of crystal, and as electricity will be used for the lighting, the effect of a palace in fairyland will be produced.

Another novelty is the panorama of a tour of the world, which will require about 27,500 square feet of canvas. It will include a theater, cafés, etc.; and men and women of the countries represented will give performances in the foreground of the panorama. A history of costume has also been suggested, and "A Street of Paris" will doubtless be a little "Midway" all to itself.

There is no question but what the 1900 Exposition will be superior in its artistic decorations to any previous exposition, and stand as a monument of the remarkable skill and genius of the French nation in that direction.

## THE HORNET AND ITS HOME.

In the study of nature we are bewildered by so many wonderful things that the real goes far beyond imagination; and the little insect we are about to look at through the eyes of original investigation presents such notable features of architectural construction in its home building that we can but wonder whence all this knowledge comes; for the hornet's nest is commenced in the early spring time by one lonely female hornet, who has succeeded in passing the winter buried in some old tree stump or rotten trunk, whither she repaired the fall previous, after impregnation, to hibernate until spring shall come.

When the warm rays of the sun succeed in making their presence felt in the hornet's hiding place, she becomes awakened to a sense of her duty, and repairs to a convenient place, be it bush or tree, and selects a site for her and her family's future home.

When a suitable place has been found, she goes to some old weatherbeaten log or rail, and gathers the wood fiber that has been set free by the elements, takes a mouthful, chews it, and mixes it with a peculiar caustic secretion of her mouth, whereby it becomes pasty, applies it to the limb, and thereby forms a nucleus for her home. This she continues to do until she has succeeded in forming twenty-four little cells or cups, which are intended for the depository of her eggs.

When this has been accomplished, she will put a covering over the nest for protection from weather. Then she will place an egg in each cell, and go on improving the home by putting another cover over the one already made, with sufficient space between the two to allow her to move about with freedom.

While these eggs are incubating she proceeds to tear down the first covering and make more cells from that material.

Meanwhile, the former eggs have materialized into tiny worms, which she feeds with small insects until they arrive at the period when the transformation from the worm or larva to the pupa or semi-insect takes place. Then she carefully places in the cell food enough to last the pupa until it matures into an insect, seals it over with a parchment-like substance, beautifully white, evidently understanding the law of the need of light for the development of the mature insect.

When the hornet comes from its cell, it does so as a full-fledged worker, and, without any previous experience, he goes to work straightway, and work of a royal kind he does. When these new-born workers come to the assistance of the lonely worker, she welcomes them by showing them every courtesy that a mother can. She leads them to the places where water and building material for the home construction are to be found.

The nest is of intricate workmanship, made from paper manufactured from wood fiber. It may be stated, in passing, that the hornets were the original discoverers of the fact that paper could be made from such materials, and the study by man of the hornet may have led him to adopt the same material, which discovery has since developed one of the greatest industries of the world, viz., the manufacture of paper from wood fiber.

Mr. T. W. Harris, in his interesting work, "Insects Injurious to Vegetation," published in 1852, says what sounds to our ears curious and interesting, viz.: "The hornets are natural paper makers, who are not obliged to use rags and ropes in the formation of their durable paper combs, but have applied to this purpose fibers of wood—a material that the art of man has not yet been able to manufacture into paper."

The insect has a scissors-like arrangement that protrudes out of the mouth, and the fine fibers that stand up from the surface of the weathered rail or log, like so many fine hairs, are clipped off, and, as before stated, are mixed with a caustic secretion of the mouth, and thereby become a paste.

The hornet, when leaving his home for more material, does so very deliberately, never seeming to be in a hurry. He will take a stroll over the nest and apparently chat with the other workmen, and, when he has loafed long enough, he will take his departure for more fiber. When he returns he reports to the master workman on the inside of the nest, then returns to where he left off and begins to force the pulp from his mouth by placing the edge of the work, already done, between his lips. His mouth opens vertically. He walks backward always in one direction, building up the leaf from the edge, and where he joined the fresh to the other material there is a distinct line, and from this mark you can tell precisely how many trips it took to make a complete nest, and the change in color of the material shows exactly when he changed his base of supplies.

No two insects work at the same portion of the nest, each one reserving a certain portion for himself, and no one dare encroach on his territory.

Different styles of architecture exist among the hornets, and there is a vast difference in the workmanship. Some do the work in a magnificent, workmanlike manner, building compactly and gracefully, while others

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are careless both in form and manner of using material. Some nests will be full of nice little nooks and corners of exquisite design, while others will be built on regular lines with no effort at ornamentation.

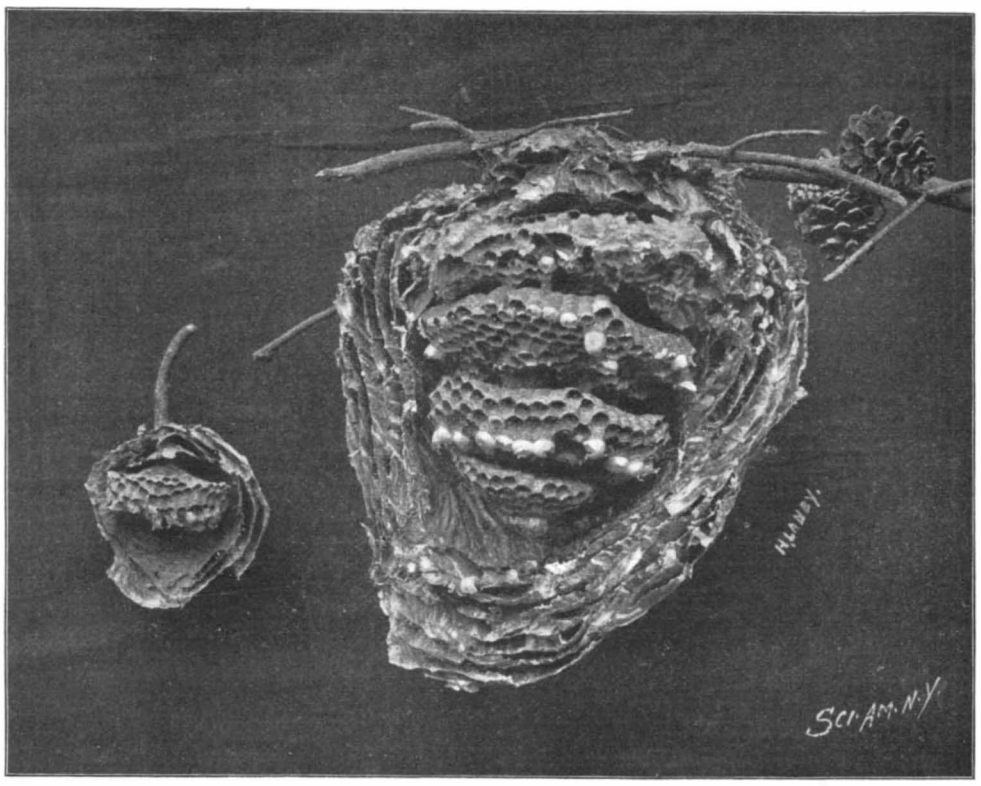
The site selected for the nest influences the style of architecture. Nests built on limbs of trees and bushes frequently include various branches with their leaves, the cells being always arranged in such a manner as not to be interfered with by the included parts of the tree.

If the nest is placed under the cornice of a house (which frequently occurs), the outside upper contour of the nest follows the line of the cornice, but the cells on the inside are horizontal.

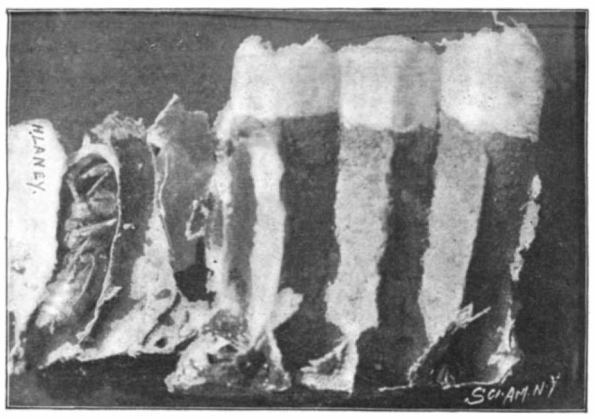
The hornet, like the bee and other insects of like nature, makes the cell of the most economical geometric figure, that of the hexagon.

They have three broods a year, which is ascertained by three fine linings that fill the cells; these are made of white material, one inside the other, in the following order: When the first young makes its exit from the cell, all the debris that remains from the shell of the previous larva is not removed, but a new bottom is placed over it, and a cup modeled up entirely independent of the original cell. This prevents any contamination from the filth left behind, and thus three, sometimes four linings, which can be removed from within each other without injury to either, are successively constructed. And the wonderful skill of making these linings perfectly free from each other, yet in perfect juxtaposition, must be seen to be appreciated. The heavy clublike antennæ are used in shaping these interior delicate cups.

The floor of each successive tier of cells is held to the previous one by tiny hollow columns which do not interfere in the least with the system of cells out of which they rise; for these little fellows never waste either space or material. The material used in these columns is much tougher (evidently intentionally) than that used merely for cell walls.



SECTION OF HORNET'S NEST. BEGINNING AND END OF SEASON.



CELLS SHOWING WHITE CAPPING AND IMMATURE PUPA.

The hornets are quite rapid at the work. A nest measuring about twenty inches in length was set on fire by some mischievous boys who wanted to see some fun, and they saw it! Somehow the nest was not wholly consumed, only the outside covering burning away. The boys, nevertheless, concluded they had enough, and did not disturb the hornets further. The unroofed house was completely mended by the clever workers within four days. Cases are known where nests were almost completely destroyed by stones thrown at them, yet in a short space of time they were remodeled, showing clearly where the new parts were joined to what remained of the old structure.

Two nests are never found in close proximity to each other, as hornets do not swarm, but continue in one community for the whole season.

In these nests there is no place provided for the comfort of the mature insects, they having to rest themselves on the roof of the cell tiers, and the only intention of the nest seems to be for the purpose of raising the young. The nest is never used more than one season; in the fall it is abandoned. One very remarkable thing is that hornets seem to have the faculty of marking the direction of a missile that is thrown at their nest.

There is always at the entrance a sentinel who will note and give warning of the approach of an enemy, and when a stone is delivered at the nest, the hand that threw it has been marked as sure as the sun shines, and before the attacking party can possibly turn the head he will feel a stunning blow in the forehead, and possibly drop to the earth with pain, for the hornet flies with such velocity at his enemy that the human body is not swift enough in its movement to get out of the way. Then the hornet flies with head and tail together, and the stinger is inserted deeply; but if the enemy gets behind a tree or bush, and throws from there at the nest and keeps his hiding place, the hornet will not likely be able to locate him, as they seem to have no power of location but by sight.

The stings of the female or neuters of hymenopterous insects, such as the honey bee, the wasp, and the hornet, are much alike, but perhaps the sting of the hornet is more to be dreaded than that of the other insects similarly armed. The sting, to the naked eye, appears to be a single needle-like organ, but when examined under the microscope it is seen to consist of three pieces, as shown in the larger engraving, a short, stout cylindrico-conical outer sheath cleft through its length on the under side and obtuse at the end, within which are partly contained two long curved lances thickened at the end and furnished on one margin with teeth directed backward. The other margin is exceedingly sharp. These lances play within the sheath, and both the sheath and the lances can be protruded and retracted. A poison duct leads from a poison sac to the ducts opening between the teeth of the lances, as shown in the enlarged view of one of the lance points.

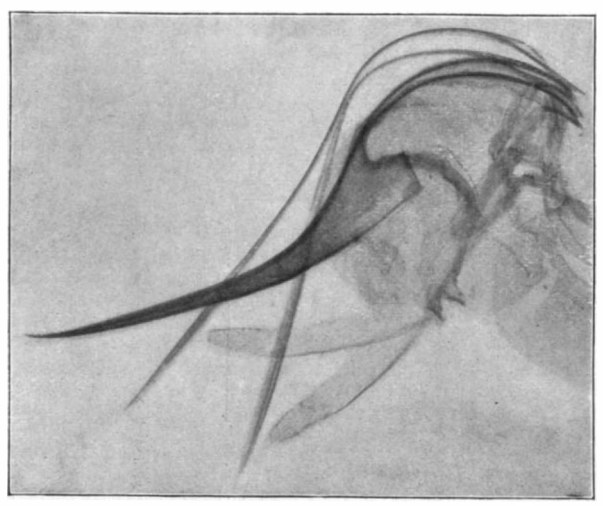
The effect of the poison introduced through the sting needs no description. Besides serving a defensive purpose, it is used also to paralyze its prey, so that it may be kept in store for future use.

Should you be taking a meal with a farmer and see a hornet come in at the window, do not hit at him or display any nervousness. It is not you he is after, it is smaller game. Watch him catch a fly and quickly tear off its legs and wings, then immediately make his escape through the window, with a morsel of food for the babies. They will attack insects very much larger than themselves in mid-air. A locust, for instance, will be conquered in a few seconds by one of these rascals, and when they have overcome their prey, they will tear the wings and legs off, and quickly repair to the nest. Sometimes the fun that the boys intend to have at the expense of the hornets is reversed, as the following instance will show:

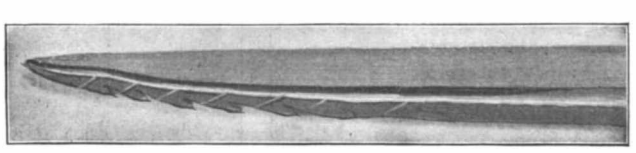
A number of farmers came across a nest in the field in which they had been working one hot summer day, and one of them suggested the fun of taking it home and burning it to see the struggles of the insects under the fire. The nest was duly plugged, the limb was cut and the branch thrown over the shoulder of one of the boys. The procession started. On the way one of the more venturesome ones slipped up under the nest, pulled the plug of grass out, but not quick enough for the carrier. Immediately the latter raised the nest high in the air hit the meddler over the head with the nest, and there was a mighty scramble for the tall grass in the immediate vicinity by the smart one, who had to do some tall wallowing before he got the hornets dislodged from himself, and when he came to dinner his mother knew him not.

The way to capture a nest so that there will be no danger from being stung is to locate the nest in the daytime. Do not disturb it until after dark. The hornets will then all be at home, and as the nest has but one exit, carefully plug up this hole, carry the nest carefully to a box in which you have placed a few small pieces of cyanide of potassium. This box should be airtight. Place the nest in it, having the lid ready. Deftly remove the plug from the nest, close the box, and allow it to remain so for three or four days. When opened, you will find all will be dead except the pupæ, which will be found sealed up in the cells, so that the fumes of the cyanide cannot get at them. Then you can watch the developing insects cut their way through the cover and come out. Then catch them and make investigations for yourself.

HERVY LANEY.



STING SHOWING LANCES DETACHED FROM THE SHEATH. × 35 DIAMETERS.



POINT OF ONE OF THE LANCES. × 150 DIAMETERS. (STUDY FROM LIFE.)

HORNET, SHOWING STING.

### The Current Supplement.

The current SUPPLEMENT, No. 1214, contains a number of very valuable articles. "The Periar Dam" describes an important engineering work which is carried on by the government of India for irrigation purposes. "Dirigible Air Vessels" is an article by Carl E. Myers, the aeronautical expert. There is published in this number a very large collection of formulas for varnishes, sixty formulas in all, many of them being for varnishes which our correspondents are constantly needing. "The Preparation of Some Properties of Pure Argon" is an important paper by Prof. Ramsay and Mr. Travers. "Bacteria and Their Uses" is a popular lecture by Dr. Seneca Egbert.

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## RECENTLY PATENTED INVENTIONS.

### Agricultural Implements.

TOOTH-HOLDING DEVICE FOR HARROWS.—Wilke J. Renken, Coatsburg, Ill. It is the prime object of this invention to provide a device for clamping the teeth to the harrow-beam, so that they may be conveniently set at any elevation and at any place on the beam. With this end in view the invention provides a clamp or holder formed with bifurcated arms, each having an opening therethrough to receive the harrow-tooth. A set-screw works in the holder in the rear of the arms, and binds the holder at any place on the harrow-beam.

PLANTER.—Theodore Crow, Cameron, W. Va. The novel features of this planter are found in the means for operating shoes and in the means for regulating the seed-drop. The means for operating the shoes consist essentially of arms attached to the shoes and of levers secured to the arms. The shoes may be raised or lowered independently as required; and, after having been fixed with relation to the ground over which they are to travel, they may be simultaneously raised or lowered. The seed-drop regulating means comprise a drop-plate provided with removable pins and operated by the movement of the machine. By changing the number and distance of the pins, the seed can be dropped any desired distance apart.

### Engineering-Improvements.

DEEP-MINE OR RELAY PUMP.—George S. Herbolsheimer, Denver, Colo. This inventor has devised a new and improved deep-mine or relay-pump, arranged to pump water out of a mine shaft at one or more levels at the same time, and to permit the connection or disconnection of the individual pumps. The pumps are arranged in pairs and are connected with a common water main. Each pair of pumps comprises two cylinders having suction and discharge connection with the water-main. The pistons of the cylinders have rods extending through stuffing-boxes in the upper ends of the cylinders. Two reciprocating power-transmitting rods extend alongside of the corresponding cylinder of each set and connect with the piston-rods to operate the pumps.

### Electrical Apparatus.

ELECTRIC RAILWAY SYSTEM. — George L. Campbell, Dushore, Penn. The system employs a closed conduit having a continuous main conductor and a sectional service conductor, a trolley being caused to travel with the car by the influence of an electromagnet. The trolley comprises a wheeled frame, below which wheels are pivotally secured. Brushes are carried by the frame. When the pivoted wheels are held in contact with the rail or other conductor, a short, perfect path for the current from the rail to the sectional conductor will be formed.

AUTOMATIC TELEPHONE-SWITCH. — Charles S. Karoly, Aurora, Ill. This invention seeks to provide a simple and trustworthy switch-mechanism in which there is a complete metallic talking-circuit, using only one half the copper line usually required, and with which a call and return or answer call can be quickly made without the intervention of the central office. The switch includes a movable plate, forming part of a circuit. A push-finger having connection with the telephone-wire is adapted for engagement with the plate to close a circuit. In the circuit a receiver-supporting lever is mounted, to which a shoe is pivotally connected to engage and move the plate out of engagement with the push-finger.

### Mechanical Devices.

MATTRESS-STITCHING MACHINE.—Elijah T. Gaskill, New Berne, N. C. The apparatus for stitching mattresses consists of a frame and of a carriage supporting the sewing-machine, provided with a shaft having an eccentric upon which a pawl fits. A spring presses the pawl into engagement with a feed-bar on the framing, and a lever and connecting-rod lift the pawl clear of the feed-bar.

PRINTING-PRESS.—William G. Johnston, Woodbury, N. J. To provide a simple means for stopping or limiting the movement of the type-bed, should the paper be broken while running through the press, and to provide a novel and improved means for operating the type-bed and for inking the type, are the purposes of this invention. The type-bed is vertically-movable and is connected by links with an eccentric on a rock-shaft. A spring-pressed lever has connection with a crank-arm on the rock-shaft, and is held in its normal position by another rock-shaft. A tripping-roller normally engages the paper passing through the press and is adapted to rock the rock-shaft to disengage it from the lever, should the paper break.

LINE-CASTING MACHINE.—Henry J. Derbyshire, Columbus, Ohio. In casting-machines as at present constructed it is necessary to make the line or slug tapering in order that it may be readily ejected from the mold. Moreover, smaller projections are cast on the side of the line, which projections are trimmed off by a knife, so as to make the line of equal thickness throughout. By reason of this operation the type buckles in the form and constantly topples over. The linotype-casting machine devised by the inventor is provided with a revolving and reciprocating casting-wheel carrying a mold having a movable wedge-shaped member for releasing a cast slug or line. A fixed pusher is adapted to engage the movable member to dislodge it and release the cast slug or line.

FLOUR PACKER.—James M. Mattingly, Hartford, Ky. It is the purpose of this invention to construct a machine in which the grinding action upon the flour common to such machines will be reduced to a minimum, and in which the flour is delivered white and granular. In order to overcome the grinding action common to most flour-packers, the inventor employs a reciprocating plunger consisting of cup-shaped packing plates, which, when forced down, compress the flour without grinding.

VENDING-MACHINE.—William H. Murphy, Fox Lake, Wis. The machine is particularly designed to distribute pencils or articles of like character. The pencils are arranged one above another in a receptacle, the lowermost pencil being located in front of a plunger, the inward movement of which is normally prevented by a barrier. By dropping a coin within the apparatus, a mechanism is operated which releases the barrier and enables the plunger to be pushed in, thus causing a pencil to be forced into the delivery-chute.

DRILL-CHUCK.—Samuel Thompson, Schaghticoke, N. Y. The idea of this inventor has been to construct a simple drill-chuck which is capable of receiving drills, the shanks of which are of different size and cross-section. He has worked out this idea by providing a pivoted cylinder having vertical peripheral grooves of various size and shape, and by clamping the drill-shank between this cylinder and a rectangular centering-block. The centering-block has grooves of different cross-section in its four faces, and is backed by a locking-plate which is pressed against it by a screw. The locking-plate is in the shape of an inverted L. It projects over the top of the centering-block, and by withdrawing it the block is also removed.

### Railway-Appliances.

ENGINEER'S BRAKE-VALVE.—John V. Wells, Wilmerding, Pa. This invention is an improvement upon a similar device patented by the same inventor. The valve is provided with a number of feed-valves set to different pressures, and connected with one another and interposed between the valve-plug and the train-pipe connection, to supply the train-pipe with pressure from the main reservoir, according to the pressure to which one of the feed-valves is set, and to maintain an increase of pressure in the train-pipe according to the pressure to which the other valve is set.

### Miscellaneous Inventions.

TOY.—George B. Hughes, Washington, D. C. The toy represents, by means of models, the destruction of the "Maine," and the victory of the United States over Spain. The figures of the "Maine," of a Spaniard, and of a pig are mounted on an inclined plane and held in place by pins. Upon operating a rod, a percussion cap is discharged; the "Maine" falls in two; and the pig rolls down the inclined plane, collides with and overturns the Spaniard before him.

GAME-APPARATUS.—George Halder, Milwaukee, Wis. This invention provides a game-apparatus in which a fortress is represented capable of being demolished. In connection with the fortress targets are employed which, when struck by bullets, will overthrow the figures of soldiers attached thereto, or will destroy a portion or all of the fortification. The fortress is provided with a tower over which there floats a Spanish flag. When this flag is struck, it falls over and in its stead an American flag rises, thus symbolically representing the capture of this Spanish fortress by American troops.

BELT-SHIFTER.—William D. Graves, St. Ansgar, Iowa. The invention belongs to that class in which means are provided for throwing the belt on and off the driving-pulley, and is characterized by a loose pulley or holder on which the belt is supported when thrown off the driving-pulley, and is provided with devices by which the belt is moved sidewise to be placed or displaced.

MAIL-STAMP.—Thomas H. Stokes, Lincoln, Ill. This mail-stamp is designed to be used for canceling stamps on letters, and comprises a base and a stamp-holding block, the two being joined by an eccentrically-located pivot, the axis of which intersects the contact plane of the base and block at right angles. The construction enables the operator readily to remove and replace type in the block.

FIREARM.—Alfredo Rosa y Pascual, Manhattan, New York city. This firearm is so constructed that a barrel of larger caliber than ordinary, or a barrel of any predetermined caliber, may be connected in a detachable manner to the stock and firing mechanism of the gun, the application being especially adapted to rifles fired from the shoulder. The inventor also provides a rest for the firearm capable of being readily and quickly inserted in the ground, together with a device whereby the barrel may not only be given any desired inclination, but may be turned as upon a pivot and secured in adjusted position.

DEVICE FOR INJECTING FUMES.—Abram R. Miller, Harvey, N. D. It is the object of this invention to provide a device so constructed that poisonous fumes can be generated and forced into holes, burrows, or nests infested by animals or insects. The device consists of a receptacle in which fumes are generated. An injector is connected with the receptacle, and is provided with a nozzle at one end and with a piston at the opposite end. The nozzle and piston ends are separated by valve-controlled partitions through which a conducting-tube is passed from the nozzle to the piston end.

SUPPORT FOR FOLDING CARRIAGE-TOPS. John S. McConnell, Argo, Iowa. This support for carriage-tops comprises a telescopic rod, one member being pivoted to the seat and the other to the upper end of a bow. A fixed rest is adapted to engage the rod when the top is down in order to support the top. The use of the device, it is claimed, will result in protecting the side curtains and also in reducing the liability of the bows' breaking.

HARNESS-BUCKLE.—Jacob Polka, Smith Centre, Kan. The buckle is formed with parallel side-bars, the front and rear edges of which are connected by cross-bars. The strap is received by an attaching cross-bar. At its middle on a pivot cross-bar a lever is fulcrumed provided at its inner end with a pin for engagement with one of the apertures in the strap, the opposite end being formed with a cross-bar operating in conjunction with the rear cross-bar at the front of the buckle to form a passage for the strap. A buckle thus made is of especial value when used on traces, hip-straps, and crupper straps, there being no possibility of a strap's becoming dislocated.

GAME-BOX.—Harry F. Williams, Hartford, Conn. This game-box is designed to be used with a series of cards having questions printed thereon, and is further designed to give answers to these questions by means of raps produced within the box. The cards are dropped into a chute and are passed through the box by the turning of a crank, simultaneously with which passage the raps will be heard. By means of a circular which accompanies the apparatus, the raps can be translated into answers to the questions upon the cards. A number of answers to the same question can be obtained.

ACETYLENE GAS GENERATOR. — Robert D. Parks, Pleasant Mounds, Minn. This apparatus consists of a water-sealed gasometer and a generator containing a carbid-receptacle. The acetylene gas is generated by allowing water to drip upon the carbid. Should the pressure or quantity of gas become excessive, generation is automatically stopped, and the surplus gas is allowed to escape through a vent-pipe to the outer atmosphere. Gas is generated only as required for consumption.

TEMPORARY BINDER.—Charles T. Rosenthal, Batesville, Ark. This binder is constructed of metal angle plates so placed together as to form several sections in which memoranda relating to different subjects can be filed. The construction is such that one or more leaves from any section, or a whole section even, can be removed expeditiously and conveniently without interfering in the slightest degree with the other leaves or sections.

BRIDLE.—Samuel Van Buskirk, London, England. This invention consists of two bits which cross in the horse's mouth, each having one end fastened to a rein and the other end to a headstall strap passing over the animal's head. When one rein is pulled, the bit to which it is fastened presses against the jaw, not only on the side of the rein, but also on the opposite side of the mouth and head; while, when both reins are pulled, the two bits assume such a crosswise position relatively to each other, that the horse is prevented from taking the bit between his teeth and thus rendering it useless.

GARMENT-SUPPORTER.—Emma Benton, Butte, Montana. This supporter consists of a flat piece of metal, with a slot at the upper end, through which a ribbon may be strung and having the other end curved around in a small roll, out of the center part of the top of which is cut a rectangular piece. An outwardly curving flat spring is pivoted to this body plate near the upper end and presses against the curved portion where the rectangular piece has been removed, thus clamping the stocking or other garment firmly. By pressing the spring, it may be slipped to one side when placing or removing the garment.

ACETYLENE GAS GENERATOR.—Jean Reibel, Angoulême, France. The distinctive feature of this apparatus is a movable belt which forms the bottom of the carbid-chute. This belt is rigged on rollers which are so connected that when the gasometer-bell falls, the belt moves forward and dumps more carbid into a chute. This chute has two elbows and an opening near one of the elbows so placed that any bubbles of gas generated in the chute will pass out into the gasogene. The water in the chute is covered with petroleum to keep all moisture away from the carbid. There is an overflow-pipe which carries off surplus water and allows of a continuous stream being run through the gasogene, thus doing away, to a great extent, with residue.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please send the name of the patentee, title of the invention, and date of this paper.

## NEW BOOKS, ETC.

AMERICAN NEWSPAPER ANNUAL FOR 1899. Containing a Catalogue of American Newspapers. Philadelphia: N. W. Ayer & Son. 1899. 8vo. Pp. 1517. Price $5.

The annual of Messrs. Ayer is a most valuable publication, and is useful not only to advertising agents, but to many other lines of business as well. It contains a complete list of every paper published in the United States which inserts advertisements, including not only the United States, but the Dominion of Canada as well. It gives particulars regarding circulation, issue, price, date of establishment, political creed, names of editors and publishers, and street addresses, together with the population of the countries and the places in which the papers are published, and the present volume contains a list of newspapers and periodicals published in Havana, Porto Rico, San Domingo, and the West India Islands. In addition to this, there are separate lists of religious and agricultural periodicals and class publications of all kinds, which are particularly valuable features of the book. Maps are provided which were made specially for the annual. The amount of work necessary in compiling a book of this kind and keeping it up to date must be incalculable. The book is clearly printed, on good paper, and it is attractively bound. The present volume is even superior to its predecessors,

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION. For the year ending June 30, 1896. Including Report of the United States National Museum. Washington, 1898. 8vo. Pp. 1107. Profusely illustrated.

The report of the Smithsonian Institution occupies less than 300 pages of the volume, and the remainder is taken up with one of the most interesting and important series of monographs which we ever remember seeing. "Prehistoric Art; or, the Origin of Art as Manifested in the Work of Prehistoric Man," by Thomas Wilson, is a delightful monograph, illustrated by no less than 325 engravings and 74 plates. The whole subject of the art of the paleolithic and neolithic periods are described. It includes flint chipping, engraving, sculpture, painting (such as it is), ceremonial objects, lapidary work, etc. Next in order we come to Stewart Culin's "Chess and Playing Cards." This is a catalogue of games and implements for divination exhibited by the United States National Museum in connection with the Department of Archæology and Palæntology of the University of Pennsylvania at the Cotton States and International Exposition at Atlanta. It is accompanied by 226 illustrations and 50 plates. This monograph is almost as interesting as the preceding one, and the Smithsonian Institution merits our warmest thanks for producing works of this kind. "Biblical Antiquities," exhibited also at the same exposition by Cyrus Adler and I. M. Casanowicz, is the third interesting monograph, and it is accompanied by 45 plates "The Lamp of the Esquimaux," by Walter Hough, is the fourth and last monograph, and appeals to the archæologist rather more than to the general reader. This delightful and portly volume is one of the finest publications which has ever been produced by the Smithsonian Institution, and the changing of the black cloth binding to a handsome green should be specially noted.

HISTORY OF PHYSICS IN ITS ELEMENTARY BRANCHES. Including the Evolution of Physical Laboratories. By Florien Cajori, Ph.D. New York: Macmillan Company. 1899. 12mo. Pp. 322. Price $1.60.

This history is intended mainly for the use of the students and teachers of physics. The writer is convinced that some attention to the history of science helps to make it attractive, and that the general view of the development of the human intellect obtained by reading the history of science is in itself stimulating and liberalizing. Strange to say, there is little literature in English upon the history of physics, although there is abundant biographical material of such men as Faraday. The volume before us is a most valuable contribution to the subject and is a serious work, the pages simply bristling with foot notes of authorities. This is, however, a very good fault.

ROUSE'S DICTIONARY OF SYNONYMS FOR THE USE OF CHEMISTS, THEIR ASSISTANTS AND APPRENTICES. London: Rouse Brothers, 61 Charlotte Street, Tottenham Court Row. 1898. Price 40 cents.

This collection of synonymous terms contains between four and five thousand references. It covers a large area and is more complete than any heretofore published. The chemists' trade, or, as we say in this country, the druggists' trade, is peculiar from the fact that most of the articles in demand rejoice in several names, and, to a certain extent, the greater the demand for a drug, the greater the number of names under which it strives to hide its identity. Even such modern synthetical chemicals as "antipyrine" boasts of four names. From what has been said, it will be seen that there is an ample field for a little book of this kind. It is an excellent volume, and we only wish we had such a book specially adapted to American needs.

MANUAL OF RECEIPTS. Being a Collection of Formulæ and Processes. Compiled from the Files of American Artisan and Various Other Sources. By Sidney P. Johnson. Chicago: American Artisan. 1899. 12mo. Pp. 241. Price $3.50.

The volume will doubtless prove of particular value to sheet metal workers. It is accompanied by an excellent index.

GENERAL VIEW OF COMMERCE AND INDUSTRY IN THE EMPIRE OF JAPAN. Published by the Bureau of Commerce and Departments of Agriculture and Commerce of Japan. Tokyo. 1897.

This little volume gives in brief outline the commercial and industrial state of Japan, and is intended mainly for the use of foreign visitors. It is accompanied by excellent maps of the country and of the principal cities, and will doubtless prove of value to those who are in any way interested in that country by reason of commercial relations with Japan.

ELECTRO-HORTICULTURE. George S. Hull, M.D., Pasadena, Cal. 12mo. Pp. 45.

The interest of the author was first directed to the subject by an article published in the Scientific American some five or six years ago. After some experimentation he carried the subject into the lecture field, and the interest manifested by farmers and students finally led him to put the matter which he was able to gather into shape, and the result is the volume before us. The subject of electro-horticulture is a most attractive one, and Dr. Hull's contribution to its literature will doubtless be warmly welcomed by advanced horticulturists.

TEXT-BOOK OF THEORETICAL NAVAL ARCHITECTURE. By E. L. Attwood. London and New York: Longmans, Green & Company. 1899. 12mo. Pp. 292. 114 diagrams. Price $3.

A new work on theoretical naval architecture has been needed for a long time, and the present volume is admirably adapted to the use of all who are in any way engaged in building or repairing vessels. The literature upon this subject in English is altogether too meager, and we are sure that naval architects all over the world will warmly welcome this volume, which gives admirable rules in concise form. The author is an Assistant Constructor in the Royal Navy and is a member of the Institution of Naval Architects.

NOTES ON WATER SUPPLY. J. T. Rodda, Eastbourne, England. 1898. 4to. Pp. 140. Price $2.

This book has no pretensions to being a treatise, but its value consists rather in pointing out a specialist from whom valuable information may be obtained, and to indicate the best water works appliances now on the market and their usefulness in the modern distribution of water supply. The book will doubtless prove of value to English readers.

Monumental Records made its first appearance a year ago in large quarto form, but, owing to the fact that the size made it rather inconvenient to bind for preservation in libraries, the editor has decided to adopt a large octavo form, which seems to meet all the requirements of such a publication. The text and photographic reproductions being printed separately will enable the use of the color prints when necessary and also to reach a higher standard in art printing. The former numbers appeared only at irregular intervals, but now the magazine will be issued regularly and the subscription price will be $2 per annum. A popular illustrated journal on archæology has long been needed, and the Rev. Henry Mason Baum, D.C.L., may be congratulated upon the successful achievement. It is published at 64 Fifth Avenue, New York, N. Y.

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## Business and Personal.

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Small Accumulators. A new book. Illus. Cloth, 50c. Spon & Chamberlain, 12 Cortlandt St., New York.

750 new and second hand iron working tools in stock, Garvin Machine Company, Spring and Varick Streets, New York.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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## Notes & Queries

### HINTS TO CORRESPONDENTS.

**Names and Address** must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

**References** to former articles or answers should give date of paper and page or number of question.

**Inquiries** not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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**Scientific American Supplements** referred to may be had at the office. Price 10 cents each.

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**Minerals** sent for examination should be distinctly marked or labeled.

(7633) J. N. D. asks: 1. About what would be the required dimensions of the glass plate in a simple electric machine, to charge a small Leyden jar? A. Holtz machines are made with plates as small as 12 inches in diameter. These will charge Leyden jars and perform many experiments. We should advise you to purchase the SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 279, 282, price 10 cents each, in which many experiments are described. 2. At what speed should it be revolved? A. The speed of the plates of a Holtz machine is only limited by the strength of the glass. 3. Where should a body be placed, to be affected most by the earth's attraction? A. A body is affected most by the earth's attraction at the surface of the earth, that is, bodies weigh most at the surface; less, both above and below the surface of the earth. 4. State three proofs that the earth is an oblate spheroid. A. One method of determining the form of the earth is by measuring arcs of meridians in different latitudes. A second is by taking the times of vibration of a pendulum at different points on the earth, and from these are calculated the intensity of gravity at those points. See Young's "General Astronomy," pages 99 to 107, price $2.50 by mail. We do not know any third mode of finding the form of the earth.

(7634) F. V. writes: While experimentally testing the efficiency of a ground wire of a telephone line from Winsted to the railroad station at Lester Prairie, six miles south of here, the ground wire of the telephone at that point was connected with the telegraph wire. A great improvement was found in the transmitter and also in the receiver at Lester Prairie; and while still commenting on this, the operator at New Germany, a station on the Great Northern four miles east of Lester Prairie, called and told the operator at Lester Prairie, by telegraph, that he had heard the whole conversation, and even recognized the voice of the speaker at Winsted, which was later actually verified, more than once. The remarkable feature of this, however, is that there is no telephone of any kind at or near the station or even in the town of New Germany. Tesla and Marconi may send their messages without wire, but they must have their instruments. But here we have an instance of receiving messages without any apparent instruments over a wire a distance of ten miles. [A. We regret to say that this matter is neither new nor strange, though doubtless your observation of it was entirely original with yourself. The SCIENTIFIC AMERICAN as long ago as 1881 contained an account of using a telegraph key as a transmitter and a sounder as a receiver of articulate speech. So far from your having no wires, you had a direct connection of your telephone wire to the telegraph line. All the rest was plain. The telephone message then went over the telegraph line, and the operator heard it at his sounder, which chanced to be well situated and adjusted for the purpose.—ED.]

(7635) P. N. writes: I am interested in a scientific problem on which I desire the evidence of or decision of a second party, and would ask you to answer the following: Suppose a man weighing 150 pounds will require to expend a force of 50 foot pounds (or a certain amount of force) to walk a certain distance, can the same man travel the same distance over the same road on a modern bicycle of 20 pounds weight with less force expended? The man is supposed to lift himself 2 inches at every step, the road is supposed to be perfectly level and smooth, time not being taken in consideration. By the above you may judge the simple question to answer. Is the human body a mechanism that, in its natural way of locomotion—walking—is superior in economy of force to one seated on a bicycle and imparting the force to the wheel? A. The bicycle is a great conservator of animal power. A man on a bicycle who can only exert one-eighth of a horse power for a few hours is more than a match for a horse in the long run. He can outdo his own walking power on a good road at least four times. If the weight of the bicycle is taken into account, the proportional conservation of energy will be somewhat greater.

(7636) J. K. asks the difference between a marine, field, and night glass. A. Marine glasses are also termed night glasses when they have a large diameter object glass, which is used at full area at night and reduced area by day, by placing a diaphragm cap over the object glass. A field glass may be a terrestrial telescope of the same combination of lenses with a very short focus, or a pair mounted for each eye. For the lower powers for field glasses, the opera glass form is used, only made longer than an opera glass, the object glass and eye lens being achromatic.

(7637) E. S. asks for the formula for a compost to imitate marble, which will be very hard and will take a high finish, and how to polish the same. It seems to be a secret; there are only a few men in this city that can mix it. A. Reduce marble dust or white limestone to a very fine powder by grinding and sifting, mix with it intimately about ¼ its weight of zinc oxide (zinc white) and ⅛ its weight of Portland cement, and mix thoroughly into a thick paste with a sufficient quantity of a hot aqueous solution of waterglass, containing about 40 per cent of the glass. Mould the paste under pressure while warm, and expose the moulded form for a week or ten days to warm dry air, before finishing.


### TO INVENTORS.

An experience of fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.


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**MARCH 28, 1899.**

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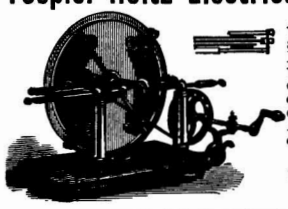

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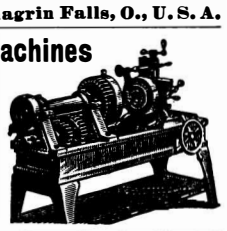

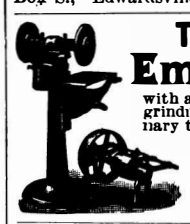

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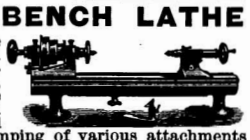

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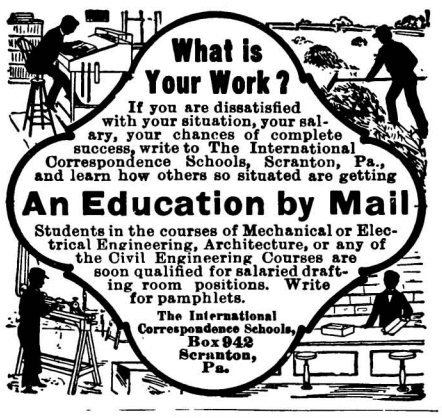

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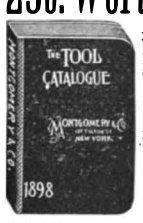


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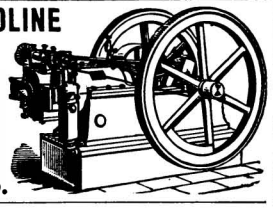

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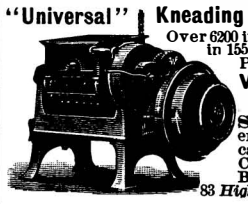

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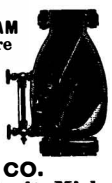

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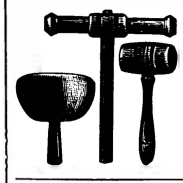

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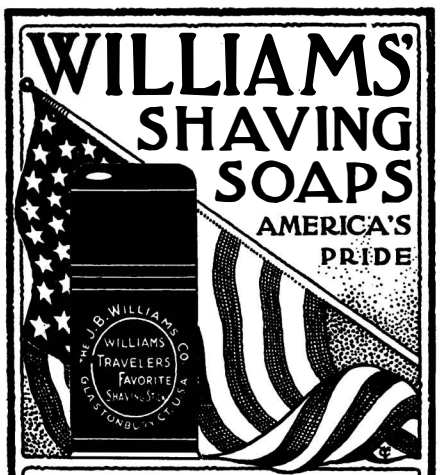


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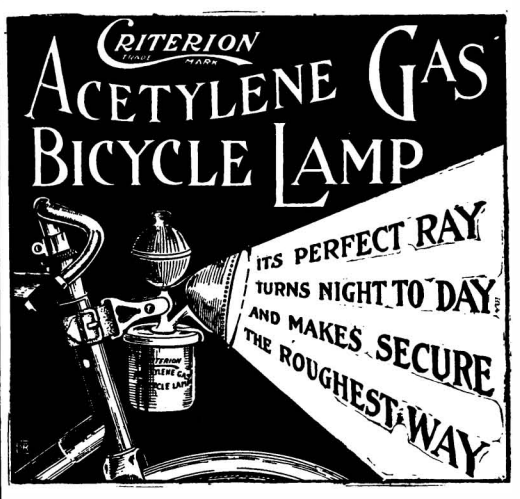


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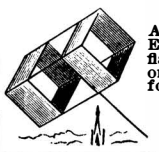

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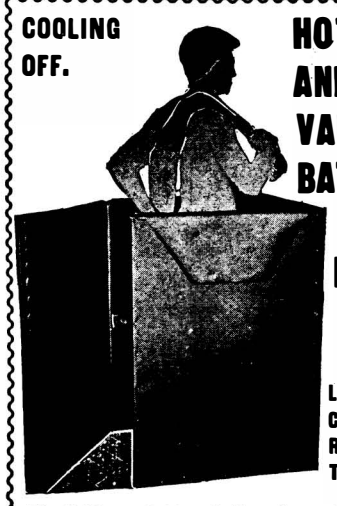

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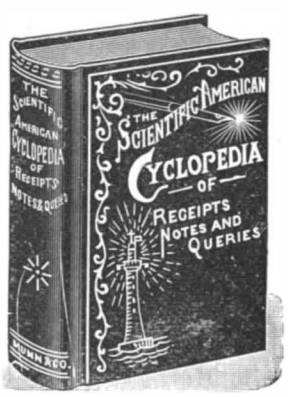


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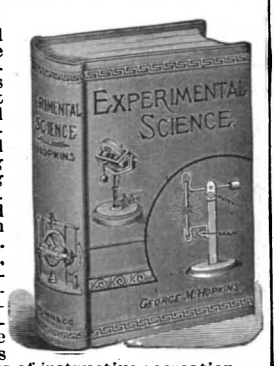

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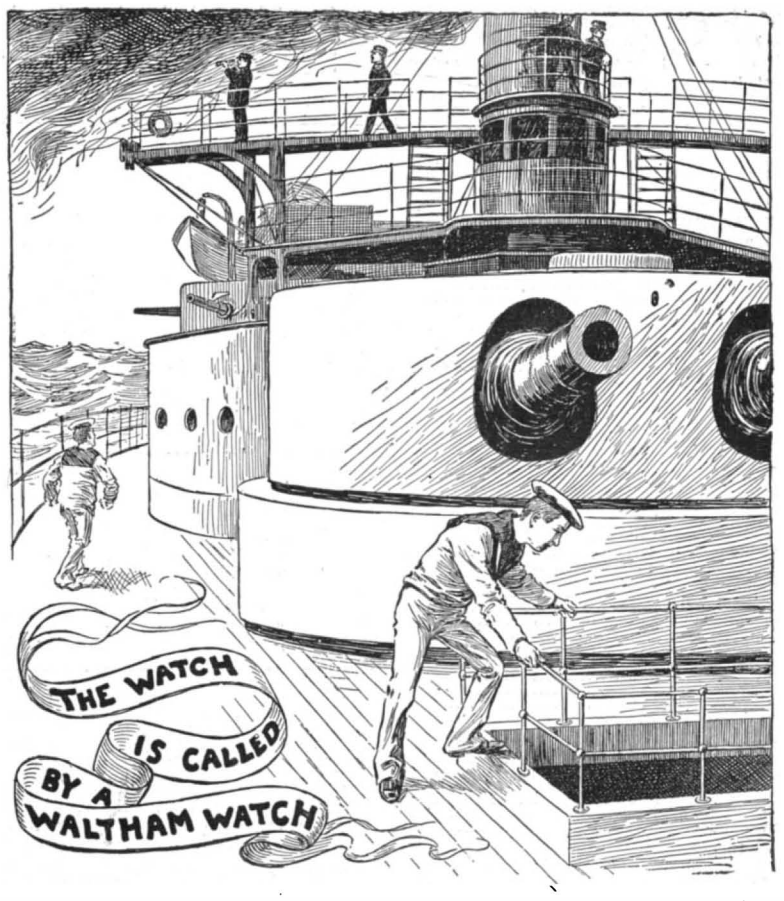


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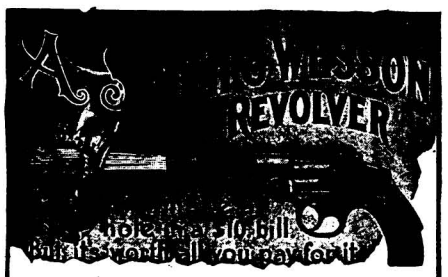


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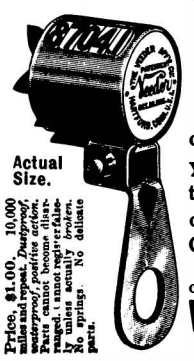

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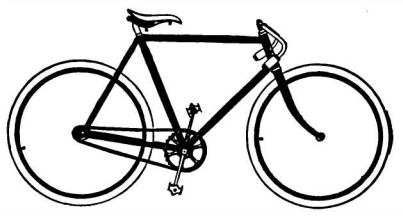

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